American Railroad Journal.

WHOLE NO. 2,581.] NEW YORK, OCTOBER, 1886. [VOLUME LX.—No. 7.

BEAUTY IN UNLIKELY PLACES.

PRETTY RAILWAY-STATIONS.

(From Cassell's Family Magazine.)

SIGNAL-BOX, LANSDOWN STATION, NEAR CHELTENHAM.

"THERE never was more flagrant nor impertinent folly than the smallest portion of ornament in anything concerned with railways or near them." Such is the explicit conviction of that arch-enemy of steam, Mr. John Ruskin.

The Brantwood philosopher, in his fervently illuminated "Seven Lamps of Architecture," decries the decoration of railway-stations as one of the most strange and evil tendencies of the present day. He conscientiously contends that if there be any place in the world in which people are deprived of the disposition necessary to the contemplation of beauty, it is there. Mr. Ruskin says that he would as soon "put rings on the fingers of a smith at his anvil," as make a railway-station pleasing to the eye. The railway-station, by the way, may be compared to the home of the smith—would he deny him Longfellow's "spreading chestnut-tree"? "It is," he continues, "the very temple of discomfort, and the only charity that the builder can extend to us is to show us, plainly as may be, how soonest to escape from it. . . . The whole system of railway traveling is addressed to people who, being in a hurry, are, therefore, for the time being, miserable. . . . The railroad is in all its relations a matter of earnest business, to be got through as soon as possible. It transmutes a man from a traveler into a living parcel. For the time he has parted with the nobler characteristics of humanity for the sake of a planetary power of locomotion."

After these vehement remarks it would, perhaps, be idle to reason with Professor Ruskin. He can find no romance on the railroad. The carriage windows of the train that conveys him from London to Coniston frame no pictures that come and go with ever-changing flight, relieved from monotony by comparison and kaleidoscopic contrast. Even the gigantic engineering works that excite the average mind by their sublime domination over the forces of nature; the lofty bridges where the traveler is

"Borne, like Loretto's chapel, through the air;"

the romance of river and rock made more ravishing by engineering realism; the graceful viaducts whose curving arches span, rainbow-like, deep and devious valleys, with wood and water far away below, and which are quite as engaging as the ruined Italian viaducts that Turner idealized—convey no more intelligent expression than that of groveling commercial greed to the supersensitive soul of the author of "Modern Painters." I quite agree with my friend, Mr. M. J. Baddeley, in his protest in this connection. He says: "Railways, in regard to their effect on natural scenery, have been abused wholesale. Poets have led the way, and everybody with a 'soul for the beautiful' has followed. They are straight and square, and altogether out of harmony with the flowing lines of nature; yet Turner's pictures abound in straight or square palaces, and level-topped bridges in the mid-distance. The churches of a rugged region, says the canon of taste, should have square towers, and not tapering spires. Why, then, should the regular lines of a railway be regarded as fatal to the natural beauty of the country through which it passes, or the express locomotive, stronger than Samson, swift and smooth as the swallow in its flight, be æsthetically regarded as a 'shrieking monster'? . . . To a great extent railways are bound to accommodate themselves to nature. They traverse a picturesque country in a succession of graceful curves, with here and there a lofty viaduct, and to the credit of our railway potentates be it said, they have shown more regard for the claims of nature, while encroaching on her domains, than any other class of men engaged in mercantile enterprise. No unprejudiced man can assert that the pass of Killiecrankie has been spoilt by the Highland railway, or that the beautiful valleys of North Yorkshire have suffered from the splendid viaducts by which the Settle & Carlisle line spans them. If there be any genuineness in the outcry against railways, it is the genuineness of a selfish, niggardly spirit, which wishes to shut out the beauty-spots of the earth from ninety-nine hundredths of its inhabitants."

This is a long quotation, but it is to the point. The railway is not the contemptible and prosaic affair that Mr. Ruskin would have us believe it to be. There is poetry in railways. Let no one, pleads Goethe, say that reality lacks poetical interest. There is sentiment in steam.

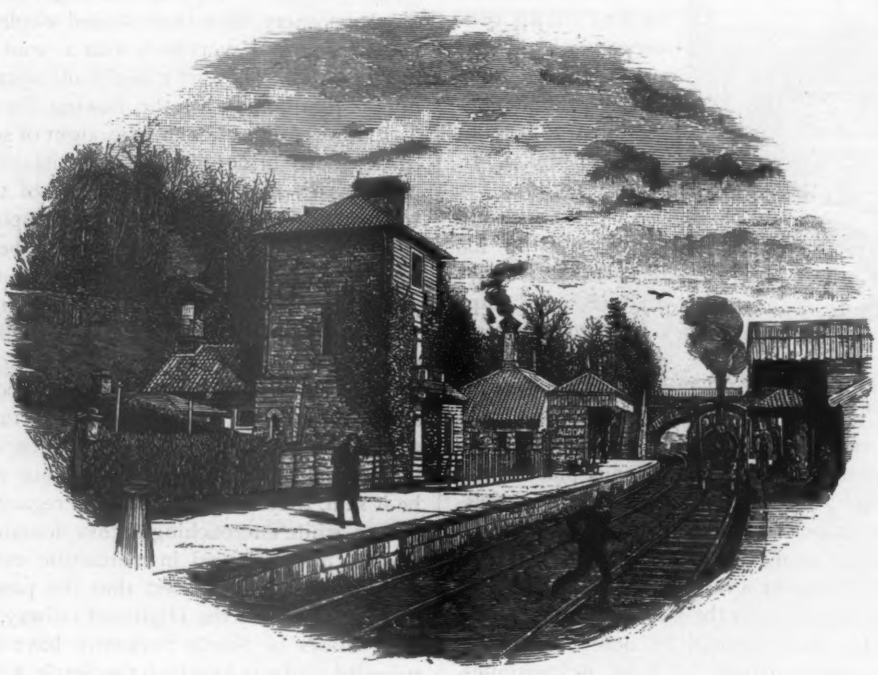
"Is this the power that has transformed the world?
This fainting thing the tenderest glassy blade
Can pierce, torn by each bramble in the glade;
Or, as it floats in thinnest wreaths uncurled,
Caught in the little ashen palms empearled,
That chafe and fret it in their babbling shade
To nothing; this that is and is not, swayed
Lighter than thistle-down by light airs whirled;
A momentary breath that scarce in May
The bedded gold can tarnish by the brook;
That yet bound in by strong necessities,
Nor at its wayward will left free to stray,
The earth beneath its flying thunder shook,
And poured behind it streaming vales and skies."

Then there is certainly something more bracing in the swift, straightforward, energizing action of the rapid express than there was in the lumbering, jerking, and jolting progress of the old stage-coach with its benumbed and petulant passengers, its heavy charges, and the dangerous vicissitudes of the road that caused the traveler to make his will before he started from London to Exeter, or Carlisle to York.

Slow trains even have their compensations, especially when they traverse a picturesque country, such—for example—as the hop-fields of Kent, or run through the pleasant Devonshire district, or skirt the Llandudno coast, or follow the Dove from Uttoxeter to Ashbourne, or the Eden from Kirkby Stephen and Appleby to the sea—the railway following the river course where the channel is belted with broad green spaces of lush meadow and flanked with picturesque heights.

The train pauses at wayside stations that are pastoral poems and pictures of happy indolence—"the negation of work in its greatest energy." The booking office and waiting rooms are embowered in flowers. Trim and fragrant hedges serve for fences. The guard stops to gossip with the station-master. Fresh-faced farmer-folk idle about the platform. The driver is evidently waiting for the squire's carriage that is being driven over the bridge, with two pretty girls, a large trunk, and a collie dog. The fast train flashes by these idyllic country-side stations, and the scream of the engine whistle does not even waken their somnolent echoes; but the town-tired traveler catches "hurrygraphs" of them sufficiently tempting for him to wish that the "limited mail" were a city omnibus, so that he could order it to stop just where he pleased.

But it is of pretty railway stations that I am bidden to discourse. Mr. Ruskin and his school would, perhaps, deny the possibility of such utilitarian institutions existing in artistic shape, despite the convincing evidence afforded by the grand Gothic pile at St. Pancras, one of the noblest architectural ornaments of the metropolis, whose booking-hall, by the genius of Sir Gilbert Scott, has a cathedral-like appearance. A vivacious American writer (Mr. N. P. Willis), speaking of the railway palaces of England, says that when London shall have become the Rome or Athens of a fallen empire, the termini of the railways will be amongst its finest ruins. The arches, gateways, and pillars of Euston remind him of "that flower of sumptuousness, the Royal Palace of Caserta, near Naples." Mr. Willis wrote his diverting "Loiterings of Travel" forty years or more ago, and the termini of the great railways have grown more impressive since the days when he sketched our scenery and society. To the modern American tourist, however, nothing is more pleasing than traveling by train through the English counties. The railway route seems to be a ribbon of gleaming steel wandering through a prolonged garden of green mixed up with old-world villages, ivied manor-houses, ancient churches, and russet farmsteads. The wayside stations, with their healthy country life, trellised with flowers, and half-smothered with trees, the gentle civilities on the platforms, the milk-cans and barrows laden with the produce of field and garden, present to him so many fleeting pictures to be recalled when far away from their surroundings.



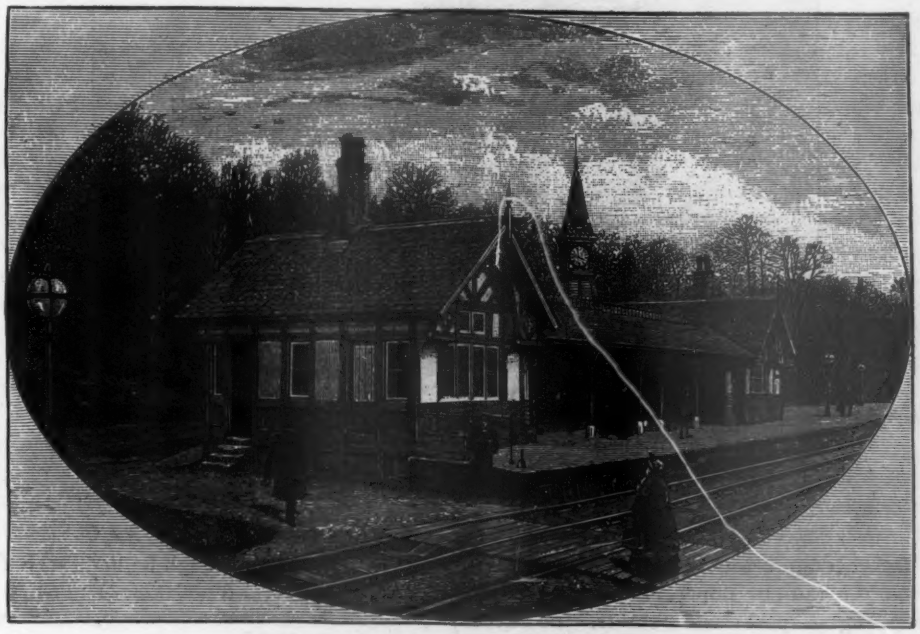
ALTON TOWERS (NORTH STAFFORDSHIRE RAILWAY).

Pretty railway-stations! I mind me of Matlock Bath, with its châlet-like appearance among Swiss-like surroundings—the Willersley cutting behind you to the south, in summer the walls of the ravine a grotto of ferns, in winter an alley of icicles hanging, apparently, from the sky, in pendants of crystal and diamond; the Masson heights to the left; lime-stone "scars" to the right; in front the tunnel burrowing its way under the majestic High Tor, like a pin-point perforating a huge sheet of gray paper.

I think of the picturesque station at Furness mixed up with the ruins of the grand old abbey, uniting the Victorian Era with the monastic life of the Middle Ages. I recall the quaint little station at Alton Towers, with its rose-garden and tree-shaded nooks, in the romantic Churnet Valley, a station that supplies the artist with a picture at every point, whether from bridge or platform, riverside or adjoining heights. I try to remember the names of some delightful Yorkshire stations which have no ambition to be thought æsthetic, or "early English before it is too late," but are, nothwithstanding, most charming revelations in the swift landscape of the line. I have most agreeable recollections of the stations between Oban and Callander (Professor Blackie out of the question!), the châlet-like stations at Loch Awe, and other calling places on the Oban line, such as Ach-na-Cloich, Connel Ferry and Dalmally—not to forget Oban station itself, with its wonder of nasturtiums climbing pillar and girder, and hanging ferns under a cheerful expanse of glass, that suggests a conservatory rather than a railway terminus.

I know of one or two tunnels that are externally positively picturesque. Travelers from the north to London, *via* Trent, must have noticed when entering Redhill tunnel the wealth of woodland at the portals, with gray baronial battlements at either side, and the telegraph masts with their web of wires carried far away up among the trees. Pointsmen's boxes even can, with their "levers" and "repeaters," and tinkling bells, eloquent of the "block system" of signaling, be made "things of beauty," if not "a joy forever." How many passengers each summer, for instance, admire the handsome station signal-box at Cheltenham? It is during the summer months a perfect "basket of flowers," and more resembles a radiant greenhouse than a prosaic receptacle for "switches" and "three-throws." Creeping plants climb up the sides of this cabin. Ornamental baskets are suspended from the eaves, from which droop festoons of flowers. The signalmen look out of windows bright with fuchsias and geraniums. Wire-stands filled with flowers are placed on either side the box, while behind is a fernery, where bright flowering plants mingle their colors with the cool grays and greens. Wild birds build in the station-roof, and become almost tame despite the rush and roar of the passing trains with their vibration and smoke.

On the lines of the West of England, pretty railway-stations are numerous. In the opening summer time, when the orchards of the beloved Western country are in flower, the stations appear to nestle amid the red and white blossoms of apple and pear trees. I do not intend to convey that these stations are models of ornate architecture. Railway shareholders, eager for their dividends, would scarcely approve of that. But still, there are quaint designs of gable, delicate suggestions of pretty windows, and artistic points about many of these wayside stations, picturesque enough for all painting purposes.



FURNESS ABBEY STATION (FURNESS RAILWAY).

The cultivation of flowers is a pleasing characteristic of English railway-stations. There are some stations—such as Dumfries, on the Glasgow & Southwestern main line, and Didsbury, on the Manchester South District—that owe their prodigal show of shrubs and flowers on the platforms to the professional nurserymen displaying his horticulture as an advertisement. It is not to these elaborate instances that allusion is here made so much as to the country-side stations, where the station-master and his man and lad spend their spare time, from the booking office and the lamp-room, in beautifying their platforms with borderings, and plants, and flowers.

And how charming is the result of their recreative efforts to travelers in passing trains—what visions of beauty alternate between bridge, and tunnel, and cutting—what pleasant glimpses of color! "The speech of flowers excels all flowers of speech," and it is heard above the

screech of the engine-whistle and the noisy rattle of wheels.

Railway directors, supposed by most people to be the most case-hardened of men, are even guilty of cherishing this taste for floral cultivation among the workers on the line. They not only give their employés garden allotments to cultivate peas and beans, cabbages and potatoes, fruits and flowers, but one board of directors (that of the Midland Railway) votes an annual sum of £100 to be distributed in prizes over the line for the most neatly-kept platform gardens at the passenger stations. Last year (1885) as many as seventy-six stations competed, and the prizes were graduated from £10 to 5s. The result was very gratifying.

Even stations such as Armley, at Leeds, and Brightside, at Sheffield, which are enveloped in foundry smoke and vitriolic vapors, despite their antagonistic surroundings, succeeded in producing pretty floral effects. At other stations, where the vegetation was in a less degree liable to be parched on the railway slopes, and suffered in a minor degree from engine sparks and "smuts," the effect of the efforts put forth was most encouraging. At Kinnersley, a station on the South Wales section, clay banks were converted into terraces of flowers, and "the desert was made to smile." At Bakewell, banks, before rough and unsightly, were planted with carpet-like turf, and diversified with flower designs and devices in shining Derbyshire spar. In the spring, they were gay with tulips and hyacinths. People came from a distance to see them. In the summer, bedding-plants were substituted; while rustic baskets with ferns and trailing flora were suspended from the roof of each platform.

It is eminently satisfactory to learn that at the stations where the borders are kept the best, the public have most assisted in preserving the plants. Where the flowers have been most profuse, the customers of the line have been their most zealous custodians. The much maligned "cheap tripper" has refrained from plucking them; and even on thronged excursion platforms, during the busy summer months, not a single bloom has been missed This encouragement gives hope of even better results in future years.

Of course, there are ugly railway-stations that admirably answer all Mr. Ruskin's requirements of uncomeliness. Even those at "show places" are not in the best of taste. That at Stratford-on-Avon is the apotheosis of the common place. It seems to act as a foil upon the old-world charm of the classic streets of Shakespeare's town. But, as Mr. Ruskin *might* possibly urge, with his sweeping method of generalization, if you make Stratford station a half-timbered edifice with quaint gables, the traveler will only care less for the house in which Shakespeare was born; and if you plant the platform with old-fashioned flowers, he will only have less pleasure in the green and bowery wilderness surrounding Anne Hathaway's cottage at Shottery. Still, the world cannot be made too beautiful; but while appreciating the beautiful we must not forget the practical. Even Mr. Ruskin's ardent arguments are not strong enough to make a "permanent way"; and his most fervid utterances are not sufficient to drive the Scotch express; although he may, with Tennyson, find—

> "—— enjoyment more than in this march of mind,
> In the steamship, in the railway, in the thoughts that shake mankind."

EDWARD BRADBURY.

RED HILL TUNNEL, TRENT.

MODERN VIEWS CONCERNING APPLICATIONS OF FLAME TO HEATING PURPOSES.

BY PROF. OLIVER J. LODGE, D.SC.

THERE is little doubt but that the experience of many engineers and manufacturers is hostile to the complete combustion of fuel—technically called the consumption of smoke—regarded from the point of view of economy. In boiler fires it is continually found that as smoke is consumed, so is the output of steam decreased; and, so long as this is the case, it is hopeless to expect the non-emission of smoke from boiler fires, except under very severe penalties, which the community would be loth to exact. In high temperature furnaces, experience of smoke consumption is far less discouraging, and there are not wanting manufacturers to assert, on apparently good grounds, that they effect some 40 or 50 per cent. economy

in coal now that they adopt a more perfect system of firing.

At first sight, economy of fuel would appear to be a necessary result of an enlightened design of furnace, and of perfect combustion; and if in certain cases this result does not follow, but rather the contrary, there must be a reason, which it behooves one to discover. In the light of the researches of Mr. Frederick Siemens, the views of Professor Armstrong, and some recent experiments by Mr. Fletcher, the reason is not far too seek.

The first and obvious ideas on the subject were somewhat as follows: Smoke combustion has been attained by the admission of an extra supply of air at a certain point of the flame, so that none of the gas formed may distil over unburnt, but that all may meet with a due supply of fresh air, unsophisticated by passage through red-hot coke, and thereby deprived of its active element. It is plainly desirable to admit no more air than is necessary, especially when one considers that every cubic foot of oxygen brings with it four or five cubic feet of inert nitrogen, which has to be raised to flame temperature, and which acts simply as a cold diluent. Hence attempts are often made to proportion the supply of air to the supply of fuel, and to allow for the rapid evolution of gas which goes on directly fresh coal is injected. This can be done in two main ways—firstly, by making the extra air-supply intermittent in quantity, to suit the intermittences of stoking, extra air being admitted every time a fresh shovelful is thrown in, and for some time afterwards, as in Prideaux furnace doors; secondly, by letting the air-supply be steady, but making the fuel-supply steady also, as with automatic stokers. It is also plainly desirable to supply this fresh air not cold, but hot; and the waste heat of the furnace is, in the best arrangements, utilized to effect this.

This being all well known, I say the first and obvious idea as to the cause of the diminution of steam supply when a smoke-consuming arrangement is introduced, is that either too much air has been introduced, or that it has been introduced cold. Either of these causes will certainly assist to produce the effect; but, considering that, however carefully they be avoided, no great economy of fuel results—at least in boilers—and considering that, unless air is so introduced, immense quantities of gas and combustible matter escape unconsumed, it is pretty plain that the cause of the paradoxical wastefulness of perfect combustion must be another and more deep-seated.

Consider, therefore, the two classes of flame; one in which combustion is imperfect, the other where it is thorough and complete—for example, say a paraffine lamp without a chimney, and the Bunsen lamp of a laboratory. The one is luminous and smoky, its radiating or toast-making power is great; but it is unable to heat bodies put into it much, because it coats them so thickly with soot. The other is clear and non-luminous, its radiating power is extremely small, but it is supposed to heat bodies put into it very well; certainly it does so better than the other. But does it, after all, heat bodies put into it so perfectly? The answer, after consideration, must be: If they are such as can become white hot, yes; if they are such as remain comparatively cool, no. A piece of thin wire, or ash, or dust, is well and perfectly heated; a cold soldering or flat iron, or a kettle, is slowly and very imperfectly heated. And why? For two reasons—firstly, because it interferes with combustion. For combustion a certain temperature is necessary. Heat mixed oxygen and hydrogen to any temperature short of this, and they hardly combine at all; if they do, it must be a very slow process. Heat them up to the right temperature, and they burn at once. Now, a kettle of water introduced into a flame instantly cools a great part of it below the igniting point, and the gas burns in a very imperfect manner, as is evidenced by the irritating smell of acetylene. That is one reason, but that is not the whole; perhaps it is not the main reason. The second reason is, that *the flame never really touches the body it has to heat.* How can it? The body is at nothing like the temperature of flame, and accordingly no flame can exist in contact with it. Combustion is not only imperfect, it actually ceases within a short distance of the surface. A layer of dark, non-conducting air or gas, at some quite moderate temperature, intervenes between flame and kettle; and across this film heat can only pass by radiation. No non-conductor is so perfect as air or gases. In so far as the film is warm, it may indeed impart some heat to the surface, but little; the great part of the heat has to be transmitted through the film by radiation from the main body of the flame. *But then this non-luminous flame is a shockingly bad radiator*, and so very little heat really reaches the surface at all. What, then, is the remedy? There are two. Either the surface to be heated must be allowed to get red or white hot, and so permit the actual contact of flame without interfering with combustion, and without interposing a non-conducting, dark, gaseous layer; or else non-luminous flames must be abolished, and highly radiating ones used instead. The former is Mr. Fletcher's plan, the second is Mr. Frederick Siemens'.

If the bottom of a copper kettle, instead of being $\frac{1}{16}$ in. thick, is, say, 3 in., or perhaps more, there is some chance that the outer skin of it may be raised to a white heat by a perfect "solid flame" burner placed underneath it. In this case combustion will not be interfered with, and a torrent of heat will pass through the copper into the water, the gradient being some 1,000 or more degrees per 3 in. Thus we arrive at the paradox that a thick-bottomed kettle may boil water quicker than a thin one. This is not, indeed, Mr. Fletcher's way of putting the matter, nor is it his plan. He proposes a multitude of studs, or ribs, to project from the bottom of the kettle, or inside of the fire-box, into the flame, to receive its heat without unduly chilling it. It seems to me that the thick slab is simpler, and likely to be more effective.

The other plan, that of Siemens', is to avoid flame contact altogether, to use a highly luminous and regenerated flame, and to work solely by radiation. This seems to me the better plan on the whole, especially as it avoids burning of surfaces.

Admitting that flame cannot really touch the ordinary surfaces which it has to heat, don't try to make it touch. Admitting that the heat of a flame must reach such surfaces ultimately by radiation, increase the radiating power of your flames as much as you can, so as to get the greatest possible advantage from them. This is probably the future method of applying combustion heat in all industries. Rich gas supplied with intensely hot air, and burning at an excessively high temperature in free space.

Returning now to the consideration of ordinary smoke consumers, the reason of their lack of economy is, I think, manifest. Without such arrangements the flame is smoky indeed, but luminous; it contains plenty of solid matter, and, therefore, has considerable radiating power. Its temperature is, indeed, not very high, nor is the combustion at all perfect; but still, as it passes along the flue, it can send out a lot of heat to the surfaces; and even when the flame has ceased, the hot carbon particles continue their journey, and radiate as they go.

But admit sufficient air-supply to render the combustion perfect, and note the change. A non-luminous, or only partially luminous flame, almost free from solid matter, now passes along the flues, and radiates to them very little. True, cross tubes are inserted for it to play against; but, as we have seen, it cannot really touch them, it must do its heating ultimately by radiation, and it accordingly is unable to accomplish very much. It is not, indeed, necessary, or advisable, or customary in practice to admit air enough to render the flame really blue and non-luminous. I have only put an extreme case.

We may sum up the two cases thus—with smoke: Great escape of unburnt matter, both gaseous and solid, and low-temperature flame, but good radiating power and large percentage of heat really given to the boiler. Without smoke: More or less complete combustion and hotter flame, but poor radiating power, and smaller percentage of heat produced really utilized. Though, as more heat is produced in this case than in the former, the actual heat utilized may be much the same in both. With some arrangements one plan gives an advantage; with others, the other.

Evidently, to high-temperature furnaces, where no cold surface need come near the flame, these considerations scarcely apply, and complete smokeless combustion can then hardly fail to be much more economical than incomplete. Though, indeed, Mr. Siemens thinks that all solid contact interferes with a flame—inducing dissociation—and he accordingly endeavors to keep flames from contact even with white hot surfaces, and to work solely by radiation.

This seems to me the direction to look for perfection: To increase the temperature of a flame by regeneration; to increase its burning or radiating power by a sufficient supply of solid matter; to keep it out of contact with a solid surface, making it play down the center of flues, or causing it to form a sheet under and around a kettle; and to adjust the air supply so that combustion is quite perfect, and no unburnt or semi-burnt gas or solid matter escapes to cause noxious smells, and to foul the atmosphere.—*Industries.*

ENGLISH AND AMERICAN LOCOMOTIVES.

No. 1.

We purpose shortly illustrating an American passenger locomotive, for the purpose of familiarizing our readers with the type of engine which has grown up in America under the peculiar conditions of that continent.

No doubt these illustrations and dimensions will be of interest to our readers at the present time, when so much is being written on the various merits of English and American engines. Though some of those who join in the discussion do so evidently in an engineering spirit, there are others who appear solely to utilize the opportunity as a means of venting a little spleen, as a kind of sop to perhaps their official disappointments or professional non-success. The question to our mind is a purely mechanical one, and, as such, requires a purely mechanical treatment. In the first place, what is the main point in which American locomotives depart from the English type, or more correctly, in what feature has English locomotive practice departed from the earlier features which formed the basis of the practice of both England and America? Clearly, the framing is this feature. Early English engines had the bar frame, and it is but quite recently that some old engines of Bury's make were to be seen at work on the Lancashire & Yorkshire Railway. They had only four wheels, all coupled, bar frames, and huge copper-covered fire-box casings. From this original type English practice has departed, and we now have thin but deep frames of plate, which admit of the widest possible fire-box between the frames. American practice adheres to the bar frame, though it is sometimes modified by flattening alongside the fire-box, and in the Wootten engine the fire-box is made to extend over and beyond the frames.

For years past the track of pretty well every English railway has been so good that engines have been built to suit such first-rate track, and such engines as a consequence are scarcely suited to run on a bad road. Many—most American tracks are very far from first-class, and though many hundred miles of track in the States are perhaps as good as any track in England, there are still thousands of miles very inferior. This cannot but be otherwise when it is considered that the line is often laid unballasted over the almost natural surface of the ground. On this account, therefore, the design of American engines has developed accordingly, and they are so constructed as to be capable of safely traversing a track which would derail an English engine. Such a design, however, does not prevent the engine from running well over a good road, and American engines have developed speeds as high as any other build. As a piece of machinery there is much about an American engine which will appear rough and ill-finished to the eye of an English workman. By this, we do not mean ill made, but the finish is rather rough and does not compare with that of English first-rate work.

There is a superfluity of molding about the dome and sand-box which hardly adds to good appearance. This will be shown in our illustrations. The wheels of even an American express engine are of cast-iron. This only proves the excellent quality of American cast-iron, and, as a detail of construction, is one which is bound to give way, as is also the English forged-iron wheel, before many years, to the wheel of cast-steel, such as may now be seen at the Liverpool Exhibition. Cast-steel will prove superior to both of the other materials and far cheaper than forged iron.

Several other details of construction are weak in appearance, but we are assured by an English engineer, to whom we referred the matter, and who has had 13 years' experience on American railways, that such is not the case. There is one point upon which we must touch, in justice

to American builders; we refer to the exceedingly free running qualities of their machines. Other things being equal, the American locomotive is freer running than is the English. This we can only attribute to the greater freedom of various parts, the free use of compensating beams, the absolute horizontality of the outside cylinders reducing rocking to a minimum, and to the arrangement of the valve mechanism. Our personal experience, and the testimony of a goodly number of drivers who have been accustomed to handle both types of engines, is in favor of this statement.

A point aimed at by American designers is evidently accessibility of parts, and, we think, no one will quarrel with us when we state that the very opposite effect has been attained by the designers of inside cylinder engines, with valves between the cylinders. Nothing could well be worse than this. At the same time, with all the conveniences to be found on a modern railway, the awkwardness is much diminished. Such a construction would, however, be quite inadmissible on an engine which might require repair 500 miles from anywhere.

To what conclusion are we forced by all these considerations, backed up as they are by the fact that England supplies no engines to Canada, for example? We cannot for a moment admit that we are unable to compete, for such an idea is absurd on the face of it. England can compete successfully with any other nation, if she cares to do so, and if English locomotive builders would do so they could produce locomotives having all the accessibility of parts seen in the American engine; they could use cast-steel wheels, produced as cheaply as the cast-iron wheel of America; they could make their fire-boxes of steel, for it is sheer nonsense to say we have no steel suitable for boilers, and nothing but ignorance could support such a statement in the face of the testimony of all the best boiler-makers of the country. As regards the bar frame, this is too simple to require comment. If called for, let it be made. Quite apart from the question of whether one engine is better or worse than another, our constructive engineers would be wise if they laid themselves out to supply a demand, not to force a sale.

New countries require many articles which differ from the articles required for similar purposes in older countries. America, as a new country, has made locomotives to suit its peculiar requirements, and thus we find her supplying other new countries to a very large extent. Probably, if tried on some of the older lines in America, such as the Philadelphia & Reading, one of Mr. Stirling's outside-cylinder 8-feet engines would give immense satistion to both the road officials and the passengers; but, if this engine were run towards the west, it would tone down gradually in estimation as the roads became more uneven.

As a rule, all constructive engineers are very conservative in their ideas. They get into a groove, and once in it nothing lifts them out. "Do you think we can sacrifice all those patterns?" say they; "why, my grandfather helped to make them when he was apprentice!" and so on.

We have personally known firms of a high reputation refuse to make little alterations in their engines, which they have been requested to make by their own agents—for climatic reasons, too. No; this part runs well at home, why not then with you; with you being perhaps 20° nearer the equator. All this may seem trivial; it is, however, very important. We have repeatedly called attention to such facts, as a matter of duty. We have heard hard swears in warm climates at many a close fit in detail which should have been a free fit; and we have seen men who have occupied good positions, where they might have learned something if they would, leave a colony as pig-headed as when they entered it; and trade keeps slipping away from us, who are better fixed for carrying it on than any other nation, and all because of our willful blindness. The American tariff is a proof that we cannot be touched in fair competition, and we go on handicapping ourselves by using copper for fire-boxes when steel would suffice, brass for tubes which are received from America in iron, and so on. We do not uphold work when cheapened by bad execution, but when cheapened by the known substitution of a cheap for a dearer—and to some minds an inferior—material, we can see no objection to it, so long as it is sold for what it is. An American engine is said by one writer to be £400 cheaper in material, etc., than an English engine, and though we cannot endorse this writer's figures, as he has scarcely the experience upon which to form reliable opinions, the statement is substantially in the right direction. Now £400, or half of this sum, is a big discount from the present cost of a locomotive, and well worth attention. We therefore maintain that the question of English versus American locomotives is not whether either is better than the other, each in its own peculiar conditions, but which type is called for by our customers abroad, why or from what special qualification the call arises, and how it can be best responded to in England.

How Englishmen See Us.

In a paper recently read before the Cleveland Institution of Civil Engineers (in England) on "An Outline History of the Locomotive Engine," by Mr. Theodore West, the author digresses from his subject to comment on American words and ways. The following are some of his remarks:

AMERICAN TERMS.

We were amused with the names familiarly applied to engines, according to their use. Thus, an engine to assist a train behind, up an incline, is termed a pusher; a midnight train is called an owl train, and an extra or express-goods is called a wild-cat or fast-freight train, because it has to look out for itself all the way, being outside the regular time trains. The difference between American and English railway names all through is amusing. A railway is always a railroad, a station a depot, carriages are cars, a chimney is a smoke-stack, guards are conductors, goods they term freight, luggage is baggage, a ticket for luggage is a baggage-check, and incline is an up-grade or down-grade; forming or leveling a road is grading it. Where we might say the fast express they call it the lightning express, just as they speak of lightning stove polish, the lightning clothes washer, and lightning apple and potato parers, and many others. Where the English guard would say, "Take your seats, gentlemen," or "Take your seats, please," according to class, the American

conductor cries out, "All aboard!" and where an official here might say to a late passenger, "Make haste, if you please," his Yankee brother would call out, "Come! hurry up!"

BAGGAGE CHECKS.

In the long, dusty journeys incident to American travel, the filter of iced-water for drinking, mostly provided in each car, and the retiring convenience parted off at the rear end, are most sensible and praiseworthy; as are some other features in their refreshment systems, the forwarding luggage by the express agencies, and the sale of tickets by various town agents at any time you wish to procure them. We do not, however, consider the baggage agency quite so perfect as they usually boast it to be, and as we found it to our cost in traveling there, and trying at two or three stations in succession to dispose of a heavy package. This had got uncomfortably loaded with fossils, minerals, and other curiosities given to us or picked up en route, and as we were going from Philadelphia to pay a flying visit to Niagara, and were pinched for time, we concluded to sort a few needful articles of dress on our way, then fasten up the bulky package and leave it at the first stopping station that allowed time, to be sent on to the shipping office at New York, just as we could have done from any English station. At one station after another, however, as we risked losing our train to try, we were invariably met with the question "Where's your baggage check?" and without this ticket (which we each time offered to pay for) on no account would they take it. First, this game at sixes and sevens was absurd and amusing, but soon grew tiresome and aggravating; particularly as one had so often heard the self-complacent boast about their perfect system of forwarding baggage. No explanation or offer to pay would induce them to touch our burden, nor condescend to explain where our default lay, until it dawned by degrees, first, that said baggage agency is generally a speculation separate from the railway company; second, with town offices, often away from the railroad station; and third, that unless you forward your baggage from the starting point independently of the railway company, you will on no account be permitted to do so en route. However, in despair, we determined to manage it; and, having a little more time at a large junction, we tried it, and being once more refused, we spied just outside the station a baggage office and a Lightning Express Company's baggage-van being loaded by a decent looking Irishman; so, coolly placing our package inside his van, he, astonished and protesting, once more demanded our baggage-check. We told him that was just the thing we were wanting and had been trying to get all day. He replied that we could get one in there, pointing to the office we had just come out of. "No!" we answered, "we had just come out of there, and the clerk was daft and couldn't understand us;" so, putting a half dollar into his hand, we told him he must take our bag, check or no check, to the depot, and set it off to New York with the rest; it was all right, and our train was just going. We left him growling and wondering wherever we had landed from, or what we could be that dared to take such an audacious liberty in that "land of freedom." At imminent risk we dived back through the crowded station, under trains coming and going, and happily rejoined our own just in time. We went on our way rejoicing, and, in due course, found our baggage in the White Star office in New York; but it was a risk despatching it as we did, and we found by that and other experiences, that the cost of this freedom from care of luggage forms a serious addition to traveling expenses, and is wanting in elasticity or adaptation to circumstances. Whilst the Lightning Express baggage system is a boon to the wealthy and well-to-do, it certainly lightens the traveler's purse, and leads us to consider our own system, whatever its drawbacks, by no means so despicable as Americans make out. On either side the Atlantic the "highfalutin spread eagle" kind of brag of an out-an-out Yankee, fully matched by the haughty self-conceit and consummate assurance of a thorough-going "Britisher," should be tempered by mutual respect and good-will, and the sweet reasonableness of common sense and fairness.

Estrade's Locomotive.

MR. A. FICTET, in a letter to the *English Mechanic*, says: "This new locomotive with driving-wheels (in fact, all wheels) of 8 ft. 3 in. diameter, is now complete, and is on view at the shops of M. J. Boulet & Co., Paris. Whether the designer's ideas of high speed will be realized may be doubted, but the following description will interest many of your readers.

"It is impossible not to be struck by the character of grandeur and power of this beautiful engine, with its six driving-wheels, of one diameter in common of 8¼ ft., mounted upon three coupled axles. The inventor's idea, it will be remembered, consists in generalizing the use of wheels of large diameter, in the extension to high speeds of the coupling of the axles of the motor, and in the adoption of a new and well-studied style of double suspension. The principal dimensions are as follows: Total length, 33 ft.; width between longitudinals, 4 ft.; diameter of the wheels, 8¼ ft.; weight of engine, empty, 38 tons; weight of engine, loaded, 42 tons. We shall not now return to a theoretic discussion of the qualities of this engine. M. Estrade has peremptorily answered this with faith and generosity by having built, as carefully as possible, and of true size, the one-tenth size model that he had deposited in the galleries of the Conservatoire des Arts et Métiers, and concerning which quite a number of controversies have already arisen. It is to be wished that some experiments shall soon be performed, either upon the lines of our large companies or upon those of the State. They will be deeply interesting and instructive. It does not appear doubtful that it will be possible to reach the high speeds of from 72 to 78 miles, for which this locomotive has been constructed. The equal size of the locomotive-wheels, and of those of the cars, will, doubtless, in a great measure diminish the resistances of friction, and permit of high speed. It must be noted that the fore-axle of the locomotive, although coupled with the others, is provided with hinged grease-boxes. On properly slowing up, then, it does not seem that it will be impossible to turn curves of the usual radius. This granted, we can appreciate what peculiar services will be rendered by rolling-stock of this kind in the India mail service and on the great rectilinear lines of Russia, Asia and the New World, and everywhere, in fact, where it is desirable to cross with exceeding rapidity great desert spaces between centers of population. Were it from but this standpoint, M. Es-

trade's rolling-stock would merit being taken into serious consideration; and it is very desirable that the experiment shall be performed in France, since it is a question of a French idea, all the expenses attending the carrying out of which have been liberally defrayed by one of our compatriots. These experiments will give us new hints, and will permit of passing a definite opinion very opportunely at the moment when Mr. Crampton, the eminent English engineer, improving upon the beautiful and effective engine to which he has given his name, is proposing a new model with three axles, of which two are to be coupled, and which are to carry wheels 6¾ ft. in diameter. In M. Estrade's *matériel*, the Westinghouse brake has gained a new success, since it has been selected after a study of all the devices capable of braking these high-speed trains.

"It is thus that a French paper speaks. Time will prove whether M. Estrade's engine is any better than those you have known well for years."

Cast-Glass Rails.

BERLIN papers copy from the *Germania* the account of an important discovery in glass manufacture made by Friedrich Siemens of Dresden, in which it was said that he has succeeded in casting glass in the same way as metal is cast, and obtaining an article corresponding to cast metal. This cast-glass is hard, not dearer in production than cast-iron, and has the advantage of transparency, so that all flaws can be detected before it is applied to practical use. It will be much less exposed to injury from atmospheric influences than iron. The process of production is not difficult, the chief feature being rapid cooling. The hardness and resisting power of this cast-glass are so great that experiments are being just now carried out at the Siemens Glass Foundry at Dresden with the purpose of ascertaining whether the material could be employed for rails on railways.

In a letter on the above subject to the London *Times* of September 7th, Mr. H. Lindsay Bucknall says:

"As the inventor and patentee of glass sleepers for railways, which have been manufactured for me by Mr. Friedrich Siemens, of Dresden, and never having heard of any idea on the part of Mr. Siemens or anybody else venturing to propose glass for the purpose of rails, I at once communicated with Mr. Siemens, and have just received the following explanation dated, Dresden, August 27th:

"'As concerns the report mentioned in several English papers about the discovery of producing rails in the same way as sleepers, I must state that the contents of this report are founded on a misunderstanding. German newspapers which took their articles regarding cast-glass from English journals, erroneously translated the English 'sleeper' into the German 'schienen,' signifying 'rails' in English; and it was this mistake which led the English papers to the opinion that Mr. Friedrich Siemens had succeeded in manufacturing rails also from cast-glass.'"

Mr. Bucknall says further: "Allow me to add, for public information, that a sample of these glass sleepers recently tested at the Anderston Foundry Company (Limited), Glasgow, resisted a falling weight of 3¾ cwt., falling upon a rail placed upon the sleeper set in sand ballast, commencing at 6 inches and rising by succeeding increments of 6 inches up to 9 feet 6 inches—the *maximum* elevation to which the test ram could be elevated—without effect, until the blow had been repeated for the sixth time. Cast-iron sleepers are expected to withstand a similar test up to 7 feet only.

"The cost of glass sleepers will be considerably less than that of either cast-iron or steel, while the material is practically imperishable as regards climatic changes and influences, or the ravages of such insects as the white ant."

H. LINDSAY BUCKNALL,
Assoc. Inst. C. E.

7 Westminster Chambers, S. W.

Report on Steel-Tired Wheels Removed and Running on the Boston & Albany Railroad.

THE following report upon service of steel-tired wheels on the Boston & Albany Railroad, by F. D. Adams, Master Car-Builder, is interesting through comparison of service of wheels manufactured by different companies, and further through the fact that very few railroad companies could furnish similar statistics on a subject of such economic importance:

"We had running December 31st, 1885, 1,493 33-inch Hartford steel-tired wheels, as per individual mileage report Of this number, 11 wheels are running between 400,000 and 500,000 miles; 135 between 300,000 and 400,000 miles; 458 between 200,000 and 300,000 miles; 463 between 100,000 and 200,000 miles; and 426 less than 100,000 miles.

"Of this number, 327 wheels have made between 100,000 and 150,000 miles before first turning; 75 have made between 150,000 and 200,000 miles before first turning; 46 have made between 200,000 and 300,000 miles before first turning; 3 have made between 300,000 and 400,000 miles before first turning; 12 wheels are now running between 150,000 and 200,000 miles and have never been turned; 21 wheels are now running between 200,000 and 300,000 miles and have never been turned; 1 wheel is running between 300,000 and 400,000 miles and has never been turned.

"Of the Washburn Car-Wheel Company's 33-inch steel-tired wheels, we have removed for the year, as condemned for passenger service, 102 wheels; their average mileage has been 281,672 miles. The 102 wheels averaged 112,433 miles before turning; 95 averaged 83,634 miles after first and before second turning; 82 averaged 58,901 miles after second and before third turning; 56 averaged 46,940 after third and before fourth turning; 29 averaged 40,724 miles after fourth and before fifth turning; 15 averaged 34,129 miles after fifth and before sixth turning; 6 averaged 27,597 miles after sixth turning.

"Of 33-inch Allen paper-wheels the total number in service December 31st, 1885, was 348. 177 removed for first turning averaged 69,472 miles; 62 removed for second turning averaged 42,499 miles; 24 removed for third turning averaged 39,521 miles; 8 removed for fourth turning averaged 30,471 miles; 2 removed for fifth turning averaged 39,202 miles.

"Of 42-inch English wheels the total number in service December 31st, 1885, was 220. Of these, 176 removed for first turning averaged 70,598 miles; 36 removed for second turning averaged 79,667 miles."—*Railway Equipment and Mileage Guide.*

Fast Time on the New York Central Railroad.

WE present herewith a schedule of the time made by newspaper special train No. 11, on the New York Central & Hudson River Railroad, between Syracuse and Buffalo, on August 8th, 1886. The train was drawn by engine No. 541, John W. Cool, engineer. The schedule is certainly a remarkable one and worthy of permanent record:

Stations.	Departure.	Distance. Total.	Distance. Intermediate.	Time between Stations.	Rate of speed per hour.
	Hrs. Min. Sec.	Miles and Hun'ths.	Miles and Hun'ths.	Minutes and Sec.	Miles and Hun'ths.
Syracuse	10 A. M.				
Oswego Junction	10 03 30	3	3	3 30	54 54
Warner's	10 09 30	9 84	6 84	6	63 40
Jordan	10 16 30	17 05	7 71	7	66 08
Weedsport	10 20 20	21 39	4 34	3 50	74 40
Port Byron	10 23 20	24 76	3 37	3	67 40
Savannah	10 29 35	31 76	7	6 15	68 29
Clyde	10 35	37 96	6 20	5 25	70 85
Lyons	10 41 50	45 23	7 27	6 50	68 02
Palmyra	10 52 35	57 84	12 61	10 45	71 62
Fairport	10 03	70 64	12 80	10 25	74 93
Rochester	11 12	80 73	10 09	9	67 27
Rochester *	11 20				
Coldwater	11 25 35	86 89	6 16	5 35	69 08
Bergen	11 35 15	98 44	11 55	9 40	73 72
Byron	11 41 10	106 16	7 72	6 55	70 72
Batavia †	11 50	112 75	6 59	7 50	52 72
Crittenden	12 03 30	128 52	15 77	13 30	71 14
Grimesville	12 12	138 11	9 59	8 30	69 33
Buffalo E. St.	12 24	148 70	10 59	12	52 95

* Stopped for water. † Slowed up.

Average speed Syracuse to Rochester........................per hour 67 27
" " Rochester to Buffalo........................ " 63 72
" " Syracuse to Buffalo........................ " 65 60

The train consisted of a baggage-car and coach. The engine had 17 × 24 in. cylinders; wheels, 5 ft. 6 in. diameter; fire-box, 72 in. long. The boiler had 1,353 square feet of heating surface. The valves had a maximum travel of 5 in., ⅞ in. outside lap and $\frac{1}{32}$ in. inside. The steam ports were 15½ in. × 1⅛.

Mixed Trains.

THE subjoined letter has been addressed by the British Board of Trade to the secretaries of the different railway companies:

"The attention of the Board of Trade has been specially directed by some of the reports which have recently been received from their inspecting officers to the practice of running mixed trains, in which passenger carriages have been attached to goods wagons. The facts brought to their notice in these reports have borne out the opinions expressed in previous reports as to the dangers arising from the running of mixed trains, especially when goods or other wagons are placed between the engine and the passenger carriages. The inspecting officers report that the risk of so placing the passenger carriages outweighs the advantages which may, in some cases of accident to the front of the train, have resulted from the wagons taking the worst of the shock. In these circumstances the Board of Trade wish to call the attention of the directors of the Railway Company to the desirability of avoiding, as far as may be, such a practice. If the running of mixed trains is not altogether avoidable, care should be taken that any wagons attached to such trains are specially constructed for the purpose, and fitted with such appliances as are generally adopted in the case of passenger carriages. The Board of Trade trust that where the condition of the traffic necessitates the running of mixed trains the passenger carriages will, as far as possible, be placed in front and not in the rear of goods wagons, and that all other precautions will be taken to lessen the risk of conducting traffic on such a system."

The Executive Committee of the Amalgamated Society of Railway Servants has passed the following resolution: "That this committee considering, as practical railway servants, the merits of mixed goods and passenger trains, knows them to be a source of great danger from breaking loose or from the breaking of the axles, and also from the difficulty of stopping the carriages conveniently at the platforms for the passengers to alight without danger; and are further of opinion that this great danger to the public and to the railway servants will exist so long as the wagons and the carriages are not fitted with continuous brakes."

Wootten Locomotives.

THE Reading Railroad has recently received ten new passenger locomotives which, the Philadelphia *Enquirer* says, "are more powerful than any ever owned by the company. They are all supplied with the Wootten firebox. A few slight changes have been made, the most noticeable in the fire-box. On all engines previously built the top of the fire-box sloped down toward the furnace door. In the new machines there is no slope, but the top is continued straight to the front of the fire-box. This secures a rather larger heating area, and consequently increases the power. The new engines have been tried and give perfect satisfaction. It is said they can run a mile in 42 seconds with a loaded train. This is at the rate of 86 miles an hour. It is believed that, should an emergency require it, a mile could be made in 40 seconds, or perhaps less. There is little probability that such speed will be required. One of the new engines has been assigned to the fast New York train that leaves Ninth and Green streets at half-past seven every morning. Two of them are now working on the Philadelphia & Atlantic City road, which at one time was very deficient in good motive power. Six or eight cars was the maximum an engine could haul and make schedule time, but the new locomotives can take eighteen cars through on time. The other engines are employed on the main line, the Lebanon Valley, and other divisions."

American Association.

PRECISION IN THE MACHINE SHOPS.

AT the recent meeting of the American Association in Buffalo, Prof. W. A. Rogers, as chairman of the committee on accurate standards, tools, and methods in the machine shop, gave an account of his work in that direction, and presented a resumé of his experiments in the use of the microscope in connection with machine tools. In this method, dimensions are read through that instrument from accurately divided scales, or, in some cases, determined by calipers or gauges accurately set by means of a comparator. By this system the workman receives from the tool-room of the shop the necessary number of calipers accurately set to the required dimensions by a skilled attendant in charge of the comparator. It is evident that in this way a high and uniform degree of accuracy may be obtained, with much saving of time and avoidance of errors, in which latter respect we would suggest that cali-

pers be returned to the tool-room unchanged, and their settings checked. For all good work, these methods must supersede the present inaccurate and inconvenient use of scales of but moderate precision, and the setting of calipers by the workman, and they will obviate the necessity of the present expensive standard gauges.

The sort of work done by these gentlemen will mark an era in the development of machine construction.

BRIDGE STRAINS.

At the same meeting Prof. Webb, of Hoboken, presented his method of determining maximum points and stresses in bridge inclines, which are applicable to trusses of the most irregular form, and to any style of loading, irregular or uniform. The method, as applied to the graphical determination of strains, was illustrated by blackboard sketches and finished drawings, and some of the features of a new notation were explained.

CYLINDER CONDENSATION.

Prof. De Volsen Wood read a paper, in which he called attention to the effect of variation in speed upon cylinder condensation, illustrating the same by experimental figures.

New Method of Making Water Gas.

THE Glasgow *Engineer* says that a new method of making water gas at an extremely low cost was the subject of a recent communication to the French Academy of Science, and that "the matter has caused much anxious attention not only in France, but all over Europe and in England as well." It is of weighty importance not only to gas but also to iron makers, if it accomplishes what is predicted of it. A jet of superheated steam is directed into a retort full of incandescent coke. The oxygen unites with carbon to form carbonic acid, and hydrogen is liberated. So far nothing new. The gases are led to a second retort filled with some refractory substance kept red hot, by which a glowing surface is exposed to the gases. At the same time superheated steam is introduced. This seizes upon the carbonic oxide to form dioxide and more hydrogen is liberated. A milk-of-lime bath removes the carbonic dioxide, and the pure hydrogen is led to a reservoir. One ton of coke in this process produces about 69,000 feet of gas, which is about eleven times the quantity usually produced by the expenditure of a ton of coal. This reduces the cost to little, if anything more than that of natural gas, when the difficulty of controlling the latter is taken into the account. This is for heating purposes. Inventors are at work devising the best methods of carburetting it, and Boulogne-sur-Seine is to be lighted with it next winter.

Durability of Locomotives.

ENGLISH engineers are giving no small degree of attention to the durability of their locomotives. The statistical details should be put in book form and preserved, as they will become interesting as the competition between the American and English type of engine increases. Mr. Johnson, of the Midland Railway, confines himself to breakdowns. In 1885, there were 60 cases in which an engine was rendered idle for half a day or more. Among the causes was the breakage of crank and straight axles, slide-valves, and valve spindles, through wear and tear; also cases of hot guide-bars, due to neglect on the part of drivers; and cases where drivers had to give up their trains. The gross engine mileage for 1885 was 43,658,427. The total number of engines 1,803. The average mileage, supposing all the engines to have been worked, 24,200. There was one breakdown for every 727,624 miles. This includes engines of all kinds.

A Notable Inventor.

THE following is copied from an English paper: "George Westinghouse owes his great and rapidly increasing wealth to his inventive genius. Twenty years ago, he was a poor young man, but he struck it rich in his air-brake for railroads, and money has since flowed into his coffers in a golden stream. He is one of the most prolific inventors of the age, and has enough good mechanical ideas to furnish every manufacturing establishment in Pittsburgh with successful specialties. He is not only highly skilled in theoretical and practical mechanics, but is also a thorough electrician. He expends an ordinary fortune every year in experiments necessary to the perfection of his inventions. By warrant of the King of Belgium he is entitled to the title of Sir George Westinghouse, having been knighted by that monarch as a recognition of his services to the world as an inventor. He is a native of New York State, and is about forty years old.

The Relative Value of Natural Gas and Coal.

OF Pittsburgh coal 55.4 pounds contain the same number of heat units as 1,000 cubic feet of natural gas. With coal at $1.20 per ton, 1,000 feet of natural gas would then be worth 3⅓ cents. But by tests made by the Westinghouse Air Brake Company, 1.18 cubic feet of natural gas evaporated one pound of water from 190° F. with the same boiler under which one pound of the best coal evaporated 10.38 pounds of water. That is, one pound coal equals 12.25 cubic feet gas, or 1,000 feet gas equal $81\frac{31}{49}$ pounds coal. This difference results from the expenditure of heat necessary to raise solid fuel to the gaseous state, which must be done before combustion can take place. In a house-grate the loss on this score from using coal would be more than in a large furnace of a factory. Hence, the greater economy in the use of natural gas is in houses and small establishments.

Feed-Water Heaters.

THE Feed-Water Heater Company, of St. Johnsbury, Vt., recently experimented on the Connecticut River road with some of their heaters, with the following result: Three heaters on engines drawing light two and three-car passenger trains 350 miles per day for ten days, connected, and same disconnected, show a total saving of 20,090 pounds of coal, or an average of nearly 700 pounds, which is equivalent to 17 per cent. of fuel saved per heater per day.

The Hinckley Locomotive Works, of Boston, which have been shut down for fourteen months, are to be started up again if the general improvement, now beginning to be felt, continues. The works have never before been shut down for so long a period.

CORRESPONDENCE.

MINNEWASKA, ULSTER COUNTY, N. Y.

To the Editor of the American Railroad Journal:

MY attention has been called to the July number of the AMERICAN RAILROAD JOURNAL, in which is published a letter written by me in 1884 to the Rogers Locomotive Works, referring to the interview with Mr. Thomas Rogers that determined the existence of the Rogers Locomotive Works.

I find in same number reference to the dates of earlier six and eight-wheel locomotives. Perhaps it will aid to more definite knowledge of the date of the earliest movement in that direction, to publish that part of a report to the South Carolina Railroad Company by me, of date May 16th, 1831, as to the necessity of six and eight-wheel locomotives, which sets forth the considerations as to the *necessity* and the conditions to be complied with in reference to change of grades and changes in direction. It will be learned from the report what were the measures proposed (and subsequently carried into practice by me on that road), and which are substantially those which continue to this day.

To a statement of mere personal interest allow me to refer: I was not, as stated, "a resident engineer on the line of railroad" for which the three locomotives were built, nor was I then "deputized to go to England and have the three engines built on plans to be decided by me." It is of no interest to any one how it happened that I was entrusted with that responsibility, but it may be allowed the old engineer (as some people count oldness) to bear in mind, and with no diminishing interest, the personal acts of the young engineer (then only a canal resident engineer) in deciding to go to the place where alone on the face of the earth the locomotive had begun *to be*, and, as I believed, was to continue to be, and, as I now know, some sixty years later, yet continues to be the great motor on all railroads; and, again, as a matter of belief, will continue to be. It was after this decision of my own that I was entrusted, greatly to my gratification, to have built the three locomotives as named.

If it happens that you do not have a copy of the "Railroad Era" pamphlet, a copy will be sent you with the good wishes of one who took the AMERICAN RAILROAD JOURNAL from its first number in 1832, and for very many years thereafter.

The pamphlet is marked copyright, as at one time I had thought some one might care to give it a wide circulation, as the facts deserve. Extracts to any extent are at your service.

When at home my address is Homewood, South Orange, N. J. HORATIO ALLEN.

[The following is the portion of the report referred to by Mr. Allen:]

"When we come to consider the application of locomotives to *wooden roads*, there are circumstances which call for attention, and a particular adaptation of arrangement to them. As the same amount of attendance and repairs attend engines of the various powers within the range that can be employed on railroads, it becomes a highly important object to place as great a quantity of power within one machine as possible. And this is more peculiarly the case on a road where the great and most difficult sources of expense are the attendance and repairs, while the fuel is comparatively of little consequence. As on every road there exists a *limit of weight* to be placed on each pair of wheels, and as on wooden roads this limit is much less than on an iron one, it becomes a still more interesting inquiry to ascertain by what means we way increase the quantity of power without exceeding the limit. On the Liverpool & Manchester road they appear practically to be limited to three tons on each pair of wheels, though some accounts state this to be too high, with their velocity, for the permanent benefit of the road. On a wooden road, where only one-half inch iron is made use of, I would put the limit at one and a half tons per pair of wheels.

"If, therefore, there can be no arrangements whereby this disadvantageous relation may be provided for, it is evident that, to convey the same quantity of goods or transport the same number of passengers, we must incur twice the expense of attendance, twice the amount of repair, and twice the liability to accident. In fact, more than twice, since in doubling the weight of the engine we are able to appropriate a greater proportion of the increased weight to steam generating purposes.

"The arrangement (?) which I would propose to effect so desirable an object would be, as the limit exists in the quantity on each point of support, to increase the number of supports, *and thus distribute the weight over a greater surface*. I would, therefore, place the engine on six or eight wheels, and limit the weight to one and a half tons to each pair.

"There arise two objections to this arrangement, from the inequalities in the line of support; the one vertical, the other horizontal.

"If three or four wheels were united on a side to the same rigid straight line, and the road had irregularities in its surface, there would arise great and injurious strains to the structure, from the wheels not being able to adapt themselves to the irregularities.

"This difficulty may be completely obviated by giving the weight to be supported but two points of support on each side, and making these points the centers of motion of the pairs of wheels.

"This arrangement will evidently adapt itself with as much ease and simplicity to all vertical irregularities, as is the case with two wagons connected together. As to the change of direction horizontally, as in the entrance of turn-outs and the passage of curves, a very simple adjustment will relieve the arrangement from all difficulty. If we connect the frame with the cross-piece only at the center, and by a horizontal point, the two sets of wheels will thereby be enabled to pass all curvatures with the facility of two simple wagons connected in the ordinary manner."

A Silver Medal to a Railway Porter.

J. THORNBOROUGH, a railway porter at Kidderminster in England, was recently presented with a silver medal of the Order of St. John of Jerusalem, for an act of heroism performed at the station in July of last year in rescuing a woman named Perkins, who had thrown herself in front of an approaching train. Lord Lyttelton, in presenting the medal, said: "They were met to reward Joseph Thornborough for a great act of heroism, and he should not depreciate the brave act done if he said that there had been many instances of bravery and devotion performed by railway servants, almost week by week, which had never been brought under the gaze of the public. It was by such acts as these that the public were able to judge what sort of men the railway servants were. (Cheers.) The railway servants of the country formed a band of 300,000 men, and they would bear favorable comparison with any body of picked men, even including our soldiers and sailors, in the country. In the great qualities of fidelity to their employers, presence of mind and resource in the moment of peril, courage and anxious care for the interests and safety of those committed to their charge, they would defy competition with any body of men that could be found. (Cheers.) It was a great advantage to a country to have such a body of intelligent, disciplined men who are ready to show such great qualities as had been displayed by Thornborough. He had great pleasure in presenting the silver medal and the certificate of the order to him, and hoped that it would prove a stimulus to all railway servants to be as daring in the hour of peril."

Porter Thornborough, in receiving the gifts, said "he felt he had only done his duty, and it was an act which he should repeat in the future if similar circumstances presented themselves." (Applause).

NOTES AND NEWS.

WILLIAM SELLERS & CO., INCORPORATED:—The title of the well-known firm of William Sellers & Co., Philadelphia, has been changed to "William Sellers & Co., Incorporated."

LIMIT TO NUMBER OF PASSENGERS ON STREET-CARS:—The Humane Society of Pittsburgh proposes to secure the passage of a law requiring horse-car conductors to display a sign whenever the prescribed limit as to number of passengers is reached. What is the prescribed limit? No one ever saw it reached in this part of the country.

THE FATALITY OF COUPLING CARS IN ENGLAND:—Mr. Clement E. Stretton, Vice President and Consulting Engineer of the Amalgamated Society of Railway Servants, says that in seven years 1.081 men been have killed, and 9,256 injured during "shunting" operations, or, in other words, 10,337 have been killed or injured out of a total of 14,000.

NIGHT SCHOOL FOR MECHANICS:—At Cedar Rapids, Iowa, Mr. Bushnell, Master Mechanic of the Cedar Rapids & Northern Railroad, has established a night school for mechanics and apprentices, who are kept from drawing, etc., until they are thoroughly grounded in the necessary mathematics. There are many applications from the best class of young men for admission to the school.

COLOR BLINDNESS:—Dr. Worms has recently brought before the Paris Academy of Medicine the results of his investigations concerning color blindness. He has examined 11,175 persons. Two of these only were incapable of distinguishing one color from another, three were blind for red and six for green, 18 could not distinguish green from red, 15 saw no difference between green or blue or grey, and 52 had a peculiar weakness in color vision in general.

ELECTRICAL TRANSMISSION OF FORCE:—A committee appointed to witness M. Marcel Desprez's experiments on the transmission of force by means of electricity, recently held a meeting in Paris. The problem was to take 200 horse-power at Creil, 56 kilometers (34¾ miles) from Paris, and to deliver half that amount in Paris. In fact, the horse power in Creil was 88; in Paris it was 40. Upon the whole the experiment succeeded well enough, and the results are satisfactory.

EARTHQUAKE ACCIDENTS:—One of the strangest occurrences attending the earthquake in South Carolina, was the wrecking of the Columbia train near Ten Mile Hill. It is said that the earth suddenly gave way and that the engine first plunged down the temporary declivity. It was then raised on the top of the succeeding undulation, and, having reached the top of the wave, a sudden swerving of the force to the right and left hurled the ill-fated train down the embankment.

HOT BEARINGS.—A tell-tale paint for showing when a bearing is growing hot, has been brought out by Mr. Henry Crookes, of 4 Westminster Chambers, S. W. At normal temperature it is a brilliant red, but as it is heated it grows darker, until, at 180° Fahr., it is quite brown. As it cools, it regains its original color again. If the bearings of an engine or machine be covered with paint, the man in charge can tell at a glance if they are running cool; and if they become hot, he can watch from a distance the effect of the lubricant he applies.

LOSS OF LIFE AND INJURIES ON BRITISH RAILWAYS:—British railway traveling cost 957 lives last year, besides injuring 3,467 people. The large majority of sufferers were railway servants, 451 being killed, and 2,117 injured. Of the passengers only six were killed, and 436 injured by accidents to trains, the remaining disasters being due to miscellaneous causes, and often through the passengers' own fault, such as trespassing, suicide, and carelessly crossing the lines. In proportion to the traffic, only one passenger was killed in over 6,075,000 travelers.

TESTS OF STEEL AND IRON GIRDERS:—Messrs. De Bergue & Co., of Manchester, have recently made a series of important tests on Bessemer steel and iron girders. These tests, which have been carried out under the direction of Messrs. Barningham Brothers, of Manchester, on behalf of the Darlington Steel and Iron Company, have had for their special object the determining of the relative strength of steel and iron for structural purposes, and the general results obtained were, with equal sections, about 40 to 50 per cent. in favor of the steel as compared with the iron girders.

APPRENTICES:—The Chicago & Alton Railroad takes a certain number of apprentices into its shops on the following conditions: There is a three months' novitiate to see if the candidate has mechanical aptitude; if accepted, he is then registered as an apprentice for three years and three months. The wages paid are:

For first three months	55 cents per day.
For next twelve months	58 cents per day.
For next fifteen months	75 cents per day.
For next twelve months	$1 10 per day.

No indentures are required, and the right of suspension or discharge is reserved. Apprentices must have an order from parents or guardians to enable them to draw their wages.

THE PACIFIC RAILROAD OF SOUTH AMERICA:—The construction of the first section of the great Pacific Railway which is to connect Buenos Ayres and Valparaiso will, the *Buenos Ayres Standard* of July 16th says, be commenced before the end of the month current, starting from Palermo Park, where it will have a junction with the Northern Railway. Mr. Clark's plans have been approved by the National Government, with some trifling alterations. The section will be sixty miles in length, and will traverse the most thickly settled districts, passing south of Luxan, not far from Mr. John Brown's estancia of La Choza, and meeting the portion of the Pacific line already made at Mercedes.

EXTENDED PISTON-ROD FOR LOCOMOTIVES:—The shops of the Great Western Division, Grand Trunk, in Hamilton, Ont., are now building some heavy passenger-engines. The engines have 6-foot drivers, and 19x24-inch cylinders. In order to give proper support to the piston, and prevent it dragging on the bottom of the cylinder, the piston-rod is prolonged through the front cover, and, therefore, supported at each end by suitable bushes and glands. This device is used in many large marine and stationary engines, but is, on locomotives, the revival of an old practice which was used on some eastern roads twenty-five or thirty years ago. It is now often used in Germany and France. The result of the experiment on the Great Western will be awaited with considerable interest.

THE PREVENTION OF A STRIKE:—Many strikes might be avoided if the course just followed in the Harmony Cotton Mills at Cohoes, N. Y., were generally adopted. The men wanted more pay, but the company told them that they could not afford an advance, and that they were already paying as much as mills in their line at Fall River and elsewhere. The men did not believe it, whereupon the manufacturers offered, if the men would select a reliable man to travel about the mills and look up the subject of wages, to pay all his expenses, and to raise the wages if they were not as high as paid elsewhere. A boss weaver has been through Massachusetts and has gone back to Cohoes with the statement that the wages there are as high as any paid in the country, and that his fellow workmen have no cause to complain.

OVERTIME AND PIECE-WORK:—At the recent Trade Congress held at Hull, Mr. Broadhurst, M. P., moved "That, in the opinion of the congress, the systematic working of overtime in many of the skilled trades of the country is an evil to the persons so engaged, and an injustice to the large body of unemployed, and should, therefore, be discontinued whenever the unions have sufficient influence for this purpose. Also that the system of piece-work, except in such trades where standard prices can be classified and maintained, is an injury to the moral, physical, and social well-being of the working people." Overtime, he said, was an enormous injustice to those out of employment, and they all agreed that 48 hours per week were sufficient for a man to labor. The congress got into a "scene" over the resolution, and it was lost.

American Railroad Journal.

A MONTHLY MAGAZINE AND REVIEW.

(ESTABLISHED IN 1831.)

PUBLISHED AT No. 23 MURRAY STREET, NEW YORK.

M. N. FORNEY, ... Editor and Proprietor.

Entered at the Post Office at New York City as Second-Class Mail Matter.

SUBSCRIPTION RATES.

Subscription, per annum, Postage prepaid..............$3 00
Single copies........ 25

Remittances should be made by Express Money-Order, Draft, P. O. Money-Order or Registered Letter.

MR. J. HOWARD BARNARD, 7 Montgomery avenue, San Francisco, Cal., is the authorized Western Agent for the JOURNAL.

MR. FREDERIC ALGAR, Nos. 11 and 12 Clements Lane, Lombard Street, London, E. C., England, is the authorized European Agent for the JOURNAL.

NEW YORK, OCTOBER, 1886.

Principal Contents of this Number.

MISCELLANEOUS AND SELECTED.

NOTES AND NEWS.

EDITORIALS.

STREET-RAILWAYS.

MANUFACTURES.

NEW INVENTIONS.

ANNOUNCEMENT.

THE AMERICAN RAILROAD JOURNAL has been sold to Mr. M. N. FORNEY, who will be its editor and owner from this date. He has also arranged for the purchase of *Van Nostrand's Engineering Magazine* on the completion of its current volume at the end of this year. The two publications will then be consolidated with the title of the AMERICAN ENGINEERING MAGAZINE AND RAILROAD JOURNAL, which will be devoted to the discussion of engineering and mechanical subjects. Railroad construction and operation being, however, the most important branches of engineering in this country, more space will be devoted to them than to any other one department of engineering. Questions of traffic and finance will not be taken up, excepting so far as they are incidentally concerned with engineering matters.

The new publication will have, each month, about double the amount of reading matter heretofore contained in the RAILROAD JOURNAL—the subscription price, $3.00 per year, will remain the same as heretofore.

The office of publication will hereafter be at No. 23 Murray street, New York.

PROFIT AND LOSS IN CARS.

IN the September number of the JOURNAL we published a very interesting and valuable paper on the "Life and Profits of a Car," which was read by Mr. E. C. SPALDING, of the Western & Atlantic Railroad, at the Car Accountants' Convention at Buffalo. In that article he gave a table, which is reproduced below, and which shows the average mileage made by cars of various ages, and also the cost of repairs done, thus giving the average revenue, expense, and net profit or loss by cars of various ages:

EARNINGS OF BOX-CARS IN GENERAL SERVICE.

Mileage.	Money.	Repairs.	Net Profit.	Per cent. Profit.	Net Loss.	Per ct. Loss.	Age of car. Years.
13,149	$98.62	$9.58	$89.04	18			1
13,478	101.08	38.13	62.95	12½			2
10,475	78.56	48.24	30.32	6			3
9,847	73.85	45.85	28.00	6			4
9,881	74.11	57.31	16.80	3			5
9,349	70.12	70.74			$0.62	1-9	6
8,968	67.26	60.74	6.52	1¼			7
9,250	69.37	55.49	13.88	2 4-5			8
9,295	69.71	49.80	19.91	4			9
7,656	57.42	53.67	3.75	¾			10

The cost of cars he assumed to be $500 each, and he points out that for the first five years of a cars' life it is a good investment, but after that it is not profitable to run it. The data which Mr. SPALDING has given is of very great value, and the paper is a model in the way of giving the information it contains in a brief and perfectly lucid form. If data of a similar character were collected on other roads and tabulated in a similar way, so as to get a broader average of the earnings and expenses of cars, it

would add to the value of the information which the author of the paper quoted from has contributed to the railroad companies of the country.

But while the facts which are given in the above table are very valuable, the reasoning and the deductions therefrom are open to question. Mr. SPALDING assumes that, when the net profit on a car no longer pays interest on its first cost, it is not profitable to run it. This would be true, if a company could get back the original cost of the car by destroying it. But if a car is broken up, the value of the old material instead of being $500 is only about $150. Therefore, so long as the car earns interest on the value of the old material, it would be profitable to run it as an investment. The earnings of the car should, however, not only pay interest on its cost, but should also pay *for the difference in value between its cost when new and that of the old material when destroyed.* The net profits given in the table are not sufficient to do this, and if money is worth five per cent. to the owners of the cars whose earnings are given, they are, according to the figures in the table, losing money. This can be shown if we put the cost, and interest on cost, of car in one column, and the net profits and the value of old material at the end of ten years in another, as follows:

	Cost of Car $500.00	Net Profit.
First year, Interest on Cost of Car............	$25.00	$89.04
Second " " " "	25.00	62.95
Third " " " "	25.00	30.32
Fourth " " " "	25.00	28.00
Fifth " " " "	25.00	16.80
Sixth " " " "	25.00	
Seventh " " " "	25.00	6.52
Eighth " " " "	25.00	13.88
Ninth " " " "	25.00	19.91
Tenth " " " "	25.00	3.75
	$750.00	$271.17
Value of old material in car		150.00
	$750.00	$421.17
Loss on car service at end of tenth year........		328.83
	$750.00	$750.00

These figures show that foreign car service does not result in a fair profit on the investment to the company owning the cars, whose earnings are reported by Mr. SPALDING. It is, therefore, very desirable that similar data should be procured from other roads, to see whether the results indicated are the same on other lines. The mileage of the older cars reported in the table seems to be very small, and it may be that the cost of repairs is higher than elsewhere. At any rate, it is very important that railroad companies should know whether they are making or losing money from their foreign car service.

Some light ought also to be thrown on the cost of repairs. Where does that money go to? If we could ascertain how much it costs to maintain the different parts of cars, we could then know the direction in which improvement is most needed. No better or more valuable piece of work could be done than to classify the cost of the repairs to freight-cars in any shop in the country, so as to be able to give the expense of maintenance of say, wheels, axles, journal bearings, trucks, draw-gear, car-bodies, roofs, and painting. It is not certain that this is the best subdivision that could be adopted; it is given merely as a suggestion, and any one having experience in keeping the accounts of a repair-shop could probably improve on it. This work would not require more than fair clerical ability, and could be done by any intelligent clerk or master car-builder, and if such information were embodied in a paper as clear as that of Mr. SPALDING'S, it would help to establish the reputation of any person who did it. which is often so important to those aiming for advancement.

AUTOMATIC CAR-COUPLERS.

THE *Railway Review*, in commenting on the confused condition in which the car-coupler question has been left by the report made at Niagara last June, and the action of the different State railroad commissions, concludes its remarks with the interrogation: "Is it not about time that something really practical and really earnest should be done with this matter?"

Probably there are few persons who know, or do not know, anything about the subject at issue, who would fail to answer "yes" to this query. The fact is, in life, this question, with reference to other subjects, has a habit of propounding itself in the most inconvenient and often importunate way.

The man or woman who is hard up and "breaks" his last greenback of small denomination, is apt to conclude that it is "about time that something really practical and really earnest should be done." The young maiden who for months or years has increased the paternal gas-bill in listening to the sentiment of her young man, with hope long delayed, often concludes that "it is about time that something really practical and really earnest should be done." An editor whose brain has been squeezed dry so often that it seems as though not a scintillation of a thought could be evolved from it, nevertheless, when the printer clamors for copy, and the time for publication arrives, resolves that "something really practical and really earnest *must* be done." But, the puzzle in such cases, and in that propounded by the editor of the paper quoted from, is to know what to do. Inasmuch as the wisdom of newspapers is not supposed to have any limit, it would, perhaps, be in order to invite our cotemporary to suggest in the form of a "resolution" just what ought to be done; and to say what person or association should adopt the resolution. This will put the contemplated and much demanded action into definite shape, and will, no doubt, receive the attention which the importance of the subject merits.

GAS LOCOMOTIVE.

THE *Scientific American* contains a description of a gas locomotive which has been in successful operation on one of the street-railways at Melbourne, Australia. It consists of a six horse-power Otto gas engine, carried on a carriage which, with the motor, weighs 6¼ tons. The supply of gas is carried in four copper containers, each 16 inches in diameter and about 6 feet long. The total cubical capacity of the four containers is 28 feet. These containers, charged with gas compressed to ten atmospheres, or say 150 pounds per square inch, represent 280 cubic feet of gas stored, which is sufficient for a run of 15 miles. Thus far, the pressure of 100 pounds has never been exceeded, which gives ample supply for running 10 miles.

The gas is compressed by an engine and compressing-pumps fixed near the line; with these the gas is taken from the Metropolitan Company's main and forced into receivers, where it remains under pressure until required for use. When the motor requires a fresh supply of gas, it is brought opposite the receivers, and the containers on the motor are connected by a short India-rubber hose to a pipe leading from the receivers. A tap is then turned, which allows the gas to pass from the receivers to the containers until the pressure is equal, then the tap is closed, the hose disconnected, and the motor is again ready to resume duty. The time required to charge the containers does not exceed two minutes. The time usually taken in running 2½ miles is about sixteen minutes, and the same time is occupied on the return journey. The heaviest gradients are 1 in 50, of which there are three, and the sharpest curve is 18½ chains radius. The number of trips run each day is eight, or a total of about 40 miles per day, except Saturday, when an extra trip is made. The motor has now been working about four months, and the average consumption of compressed gas is 702 cubic feet per day, as measured by the meter through which it is taken.

The engine is fitted with friction gearing, which allows it to work in one direction, and so avoids the delay of stopping and starting.

The power of the gas engine is derived from a fuel which has no weight, of which a large quantity can be carried without adding to the load, and the supply, it has been shown, can be replenished with the greatest ease. No boiler, coal, or coal bunker is required, and one man, not necessarily a mechanic, is all that is needed to take charge.

The fact of a motor of this kind running 40 miles a day for four months has established the principle, and has proved by demonstration what can be done with locomotives on this plan.

Street-Railways.

THE LABOR QUESTION IN JAPAN.

A CORRESPONDENT of the *New York Tribune* gives the following account of the way the Japanese have treated the labor question in that country:

"Street-railways were introduced into Tokio, the capital of Japan, about four years ago. Conferences between employers and workingmen are common events in that country, and before the inauguration of this new enterprise, it was proposed and agreed that, in addition to the regular monthly wages, each driver and conductor should receive a small percentage on the gross receipts of the car to which he might be attached. This proportion was fixed, in most cases, at one per cent., which had the effect of adding one-quarter, or, under fortunate circumstances, one-third to the customary stipend. The purposes on the part of the employers were to keep the drivers on the alert for passengers; to insure such behavior on the part of conductors as should make the line more popular than the old-fashioned omnibuses; and to provide against objections to extra work, when such was thought requisite or desirable. It might be difficult to estimate the possible result of a similar experiment here, and no comparison could well be based upon wage rates so low as those of Japan. Moreover, our capitalists would probably be rather diverted than edified at the idea of receiving hints from the far east on such a subject. Nevertheless, it is interesting to know that the relations between the owners and the laborers have always been harmonious; that nothing resembling a strike has ever been remotely contemplated; that the workmen are willing to perform extra labor on account of the chance it affords for increasing their earnings; and that the capitalists find it well worth while thus to stimulate their people by giving them the trifling share of the gross revenue."

In commenting on the above, a correspondent of the RAILROAD JOURNAL says:

"Japan, a country new in the world of nations, takes a step ahead of the great American Republic. The above letter leads us to ask why some Americans do not improve on the Japanese idea, by paying the street-railroad conductors five per cent. on receipts in excess of \$18.00, *in addition* to regular or present wages.

"If, for example, the average receipts of a Sixth Avenue street-car conductor are \$20.00 per day, to give him five per cent. on all receipts above \$18.00 per day would be an incentive for him to pass over each day, in receipts, all that his car could possibly take in."

It is to be feared that some practical difficulties would be encountered, in actual service, if such a system were adopted. In the first place, the earnings of a street-car are to a very limited extent only dependent upon the efforts of the conductor. A few seconds' time may increase or diminish the receipts very materially. If a driver will run behind his schedule time, he will pick up all the passengers that accumulate along the whole length of the line during those seconds. A percentage on earnings would, therefore, be a constant incentive to "loaf" or run behind time. All travelers on the old omnibus lines on Broadway can remember how the drivers would loiter on the way in order to pick up passengers. To be just in time, and not too late, for the dispersion of the audience of a popular theatre, or other place of amusement or assembly, would make a very material difference in the earnings of a street-car and the percentage of the conduc-

tor, but might cause serious disturbance in the running time of the cars.

It is doubtful, too, whether the plan proposed would be an incentive to honesty, because, if a conductor is not watched, it would be safe to pilfer when the receipts are above the average, and it is only then that he would receive a percentage. In other words, a dishonest conductor could probably make more by stealing from the company than he would get in extra percentage on receipts. Besides, he might steal and also get a percentage which would be only slightly diminished by his stealth.

It is very desirable that all persons who labor in any way should be paid in proportion to the work and the quality of the work they do; but piece-work is very generally opposed by trades unions, and they have some good grounds for their opposition.

We hear a great deal now-a-days about coöperations, and all kinds of schemes are proposed for giving workingmen an interest in the profits on what they produce. The fact is, though, that we can hardly conceive of any organization which would give greater facilities to employés to become coöperators than an ordinary stock company does. Any railroad employé, for example, may acquire an interest in the corporation he works for, by saving his money and buying one or more shares of its stock. He can do this at any time, and if he should be inclined to part with his interest, it can be done without difficulty or delay. He can convert his stock into money, or his money into stock, at any time; and he has the same rights, and privileges, and advantages as the richest owner in the company, proportioned, of course, to the amount of his holdings. It would seem as though it would be a good plan for corporations to encourage their employés to own stock in the companies they work for. This could be done by fostering economy and providing safe depositories for the savings of the employés, and then, when men are employed, giving the preference to those who are holders of stock.

The great difficulty in the way is, that so small a proportion of mankind have sufficient self-restraint to save money; and when it is remembered that capital means simply *savings*, it can be understood why there is and always will be such a wide gulf between those who will and do save, and those who do not. There is a large class of people who find it so difficult, as to be almost impossible, to save anything beyond what is required for subsistence. Such people say, and are now saying it with much vehemence, that "our only capital is our labor, and we want labor's just share in the profits." Probably we shall, within the next decade, see many experiments made in the direction indicated by our correspondent, and there is no doubt that if some method could be evolved which would be mutually advantageous to employer and employé, and which would compensate the laborer in proportion to the value of his work, it would give a fresh stimulus to human progress, comfort and happiness.

CABLE TRAMWAYS.

A WRITER in the *Mechanical World*, after describing the cable roads of San Francisco, says:

"With respect to the control of the cars, the control of the management and the stopping and starting of the cars, that has been tested in almost every conceivable circumstance, and the writer cannot conceive of any manner of stopping a car and bringing the same to an absolute stop in so short a time as is done under the cable system. The man in charge of the grip takes the place of the man in charge of the horses on horse railroads. A horse has a mind of his own, has a brain and heels, and requires the attention of the man in charge to look after him as well as the brake. In the cable system the grip-man looks after the brake and has no horses to look after, and consequently has immediate and absolute control over the starting and stopping of his car. Moreover, he stops it absolutely. When a passenger gets off there is no jerking and grasping hold of the strap to keep his equilibrium, but the car is stopped at once. The writer has seen on Clay street, in San Francisco, where the car has been stopped and a tumbler filled with water held in the hand of the superintendent standing in the car, and the car then started without spilling a drop of the water. This shows what control of the motion of the car a man with some experience at the grip possesses.

"As to noiselessness. All the clatter of the horses is done away with. The cable car moves along smoothly and quietly and regularly, without jerking or thumping on the grades or anything. In fact, the grade makes no difference, so long as it is not so steep as to tumble the passengers into one end of the car. There are grades in San Francisco on the line of the cable railroads from 1 foot in 5 feet; and in the city of Dunedin, in New Zealand, the cars are running on a grade of 1 foot in 4½ feet, and on the Highgate-hill line they are running over grades varying from 1 foot in 12 feet to 1 foot in 7 feet.

"There is also another point to be considered, and that is with regard to the capacity of the cars and the carrying capacity of the road. This capacity is almost unlimited, because there is no limitation to the number of cars which can be used within the horse-power of the engine, and cars can be added within the range of the engine, so as to meet all the varying demands of travel. Single-deck cars or double-deck cars can be used, which can be run in trains of one, two, three, or four extra cars to one grip-car, or can be made up and operated as a single car and grip-car which can be run every quarter of a minute, or with just time enough to keep the way clear. Double-deck cars can be made to carry 44 inside and 32 outside comfortably seated, and with this system there should be no difficulty under ordinary circumstances of furnishing a seat to each passenger, so that the capacity of the system must be considered as unlimited.

"As to the popularity of the system: In San Francisco, as in Chicago, it was found that the horse railroads were

not paying so well as they might, and they had to change them to some other systems; and some of them were converted into cable roads, and such are now paying handsomely. The Sutter street road, which, prior to its conversion into a cable road, had its stock selling for £4 10s. or a little less, is a successful road, and its stock is selling now at £20. They give transfers along their main line running east and west and north and south, parallel with the ocean. The Geary street railroad, which cost about £8 a share to build, to the original stockholders, is selling for from £19 to £21. So it is with the other roads; so it is with the Chicago roads; the stock has advanced.

"Testing the operation of the cable system in the city of Chicago by public opinion, it will perhaps be sufficient to say that the surest way to raise a public clamor is to attempt, when any accident occurs which renders it necessary, the substitution of horses for the cable, and under which the public would have the same facilities precisely as it formerly had. In the city of Chicago, and particularly upon the south side, in public judgment, the cable has become a necessity, and is finally demanded as a right, and nothing draws down upon the Chicago City Railway Company more hearty denunciation and criticism than the substitution of horses for the cable system, even for an hour, whenever the emergency does demand it.

"As to the economy of the system: The economy increases in the cable system in proportion to the amount of business done. That applies to all roads, but you can save from 60 to 75 per cent. in the cost of operating a cable road as compared with a horse railroad. This means that you can operate your road and carry people at a less fare. That affects the public more than anything else.

"It is held by chemists that after snow falls some ammonia is raised in the atmosphere. A little ammonia is beneficial, but not such ammonia as you get from the decomposed urine and its germs, and from the decomposed fæcal matter with its offensive odor. Every horse discharges 10½ pounds of fæcal matter and $4\frac{4}{10}$ gallons of urine per day, thus assisting to render the air impure.

"Horse manure evolves a large proportion of ammonia. Ammonia is considered an unhealthy gas diffused in the atmosphere, when inhaled to a large extent; a little smell of it is very agreeable. But this is hardly a fair way of putting that subject, because, in the liberation of the ammonia, there are other objectionable substances; there is what is called the sulphide of ammonium, which is very unpleasant; and then, in connection, there are germs. As to the question whether the average of the lives of horsemen is lower than the average of the lives of other people, much is not known, but it is a matter of popular belief that men who are engaged in any of these occupations, like plumbing, for instance, do not mind sewer gas at all; that they become used to it.

"While we can, to a large extent, sweep the solid matter up, we cannot do so with the liquid matter, and that soaks into the crevices, and in warm weather undergoes decomposition. The exhalations from the lungs and skin and the gaseous rectal discharges of the 80,000 horses in a city such as New York is a pretty serious matter. A town with 80,000 people in it is a very good-sized town—a crowded city, and here we have this enormous number of animals.

"After the pulverization of the solid matter by hundreds of thousands of wheels, so that we have it in the most favorable condition for a good March wind to blow the dust about, it becomes a very serious matter to the lungs. The fact is, this dust is mostly pulverized manure, and it is blown in the gutters, and if somebody throws the lighted stump of a cigar into it it kindles a fire.

"It is not like dust and earth; it is organic matter in decomposition. This dust may have certain simple mechanical effects. Thus, for instance, it may affect the eyes and nose. It is not only blown into the face, but it is carried in our clothing; and if the ladies with their beautiful dresses and elegant bonnets knew they carried more or less a load of manure on their heads, their bonnets would not, perhaps, please them so much. But it is more serious still; it is taken into our lungs. Let us reflect for a moment; for that which we inhale this way there is no mode of exit. When an autopsy is made of the body of a man who has worked in a coal mine, the lungs are found black with fine dust. If we open the lungs of a man who worked with iron, the oxide of iron gives a redness to the lungs. So, in the lungs of a Londoner, if you should open them you would find manure. See the contrast between the lungs of these and those of a Venetian. Those who have been to Venice know that there is not a single horse there, and, of course, the people cannot get any manure in their lungs. Again, the dust enters our houses, and it has been pointed out and exhibited to our citizens that the dust in our houses is mostly manure. Take a piece of glass and moisten it slightly with glycerine and leave it. It collects the dust, and this is mostly manure. You may close the doors and windows, but it might almost be said of it, as of the dust of the simoon, that it will pass through the shell of an egg. When the summer season comes we have the decomposition of the urinary discharge, and if we come from the fresh air of the seashore into the town, we recognize at once the flavors. Then, again, when urine comes into decomposition we have all kinds of germs developed.

"The construction of these roads and conversion of the other roads from horse roads to cable roads dispense with the services of about three thousand horses in the city of San Francisco. What must be the number of horses in cities such as London, Liverpool, or Glasgow. Of course, when you take into consideration 3,000 horses with their natural droppings, and consider the effect they must have on the sanitary condition of a large city, it must at once strike you that the cable system has an immense advantage over the horse system.

"Under the cable system in Chicago two detentions of short duration took place, and during which the company were compelled to operate with horses on a portion of the lines, owing to weakness and defects in the machinery, which were promptly and easily remedied. Experience corrects all accidents and evils of this character, and the longer the roads are operated the less and less frequent become such detentions, until finally the system has, with us, ripened very nearly into perfection, and it is safe to say with regard to the practical operation of the cable system in the city of Chicago, that if it were put to vote, not one person of either sex out of 10,000 would cast his or her ballot for the restoration of the old method.

"In London the same satisfactory result has been ar-

rived at. During the past winter the traffic upon all the lines in the north of London, except the Highgate cable line, was deranged, and in some instances absolutely stopped, in consequence of the snow storms; but upon the Highgate line not a single trip was lost, and the cars ran as regularly as if nothing had occurred, hauling up the hill wagons heavily laden with coal and other goods.

"The most marked and decided effect of the adoption of the cable over the horse system is the improvement in the grade of men employed, not only in the grade of men generally, but in the same man, when he is promoted from the driving of a horse to the handling and management of a cable-car.

"Wherever the cable system has been introduced and tried, people are pleased with it. They feel relieved, from the simple fact that it does away with any anxiety as to trouble with the horses, and they feel they are not imposing upon animals to exert themselves to do all they can, and more than they should, in carrying them in their daily travel; besides, they are carried surer, quicker, cheaper and more agreeably. It is found by experience that there is less danger in entering and alighting with respect to cable railroad cars. This is a matter of great importance, especially in respect to children, aged and infirm persons; and it is generally stated, more particularly by persons of advanced years, who find it difficult to get on and off street-cars propelled by horses, that the cable system has relieved them of immense anxiety in this respect. This is because the man in charge of the grip has nothing to do but to run that. His business is to manage the grip. His mind is left free except in regard to the grip, and he has complete control of it."

Glasgow Street-Railways.

THE street-railways of Glasgow (Scotland) are owned by the municipal authorities and are worked on the principle of being a source of revenue to the rate-payers of the city. In 1871, the Glasgow corporation obtained parliamentary powers to borrow money for the purpose of constructing a complete tramway system throughout the city; and when the lines were finished they were leased to the Glasgow Tramway Company for twenty-three years on the following terms: Payment of (1) the rate of interest on the actual money borrowed to construct the works; (2) payment of 3 per cent. on the actual cost, to form a sinking fund to wipe out the cost of the works by the expiration of the lease in 1894; (3) payment of 4 per cent. to form a renewal fund, and (4) a rent in the form of £150 per annum for every mile of tramway in actual use within the city boundary. The tramway company also lodged with the corporation bonds on heritable property to the extent of £60,000, as a pledge that they would implement their bargain. The various payments the tramway company have to make to the city authorities in terms of the lease, amount in the aggregate to £29,000 per annum, or £560 a week. The permanent way is kept in order by the tramway company, who are reimbursed for any repairs they make, out of the renewal fund lodged by them with the corporation. Practically, the lines are not only a source of income to the corporation, but their cost is being gradually wiped out, and at the close of the present lease the city will be in possession of a valuable property that has not cost the citizens a single penny.

The tramway company, who work the lines and who possess a complete monopoly of the street passenger traffic of Glasgow, is a good dividend-paying concern, their highest distribution of profits being 11⅓ per cent., and their yearly average from the beginning until the present date 6 per cent. Recently, an underground railway was opened, but as yet it has had no material effect on the drawings of the tramway company. The capital of the tramway company amounts to £315,000; the miles in operation, 26 miles of double road (steel); and the passengers carried, over 800,000 a week. A uniform charge of one penny (two cents) per mile is made for each passenger, inside and outside the cars alike, and the city is marked off into mile and half-mile stations, so as to enable the conductors to levy the fares. Children between five and twelve years of age are charged half fare, and a special service of workmen's cars is run at the reduced charge of one-half penny (one cent) per mile. An elaborate system is in operation to prevent dishonesty on the part of employés, the salient features of which are the use of the bell-punch, and the depositing of £2 by each conductor as security for his intromissions. The cars are drawn by horses, the directors of the company being of opinion that they can obtain better financial results in that way than by the use of steam. The company have everything within themselves, that is to say, they construct cars, make harness for horses, and have shoeing forges, and a block of dwelling houses for their workmen. Their stud consists of 2,507 animals (2,253 horses and 254 mules), and the distance run daily is about 12¼ miles by each team. Provender, an important item in tramway management, is dealt with in this way. Each horse is allowed 27½ pounds of food daily, made up as follows: Maize, 11 pounds; hay, 9 pounds; oats, 6½ pounds; bran, ½ pound, and linseed, ½ pound. In addition to the passenger fares, the company draw a revenue for advertisements displayed on their cars, the carriage of parcels, the carriage of mails between the different railway stations in Glasgow and the general post-office by special vans, and the conveyance of letter carriers from the post-office to the various delivery districts, also by special vans. A limited number of cars are run on Sundays. In one of the suburbs of Glasgow there is a tramway line worked by steam, but this is a comparatively small concern. The directors of the Glasgow Company do not desire steam-cars, but, even if they did, it is unlikely that parliament would sanction the use of steam in the streets of a busy city.—*Bradstreet's.*

Cable "Tramways."

IN a report on this subject, the Public Works Committee of Birmingham, England, arrived at the following conclusions:

"1. That the cable system is practical and suitable for the routes proposed.

"2. That under proper regulations it appears to be as safe, if not safer, than steam, and as safe as horse traction.

"3. That with a frequent service of cars, it appears to be cheaper to work than horse traction, and as cheap as steam traction, even with the extra capital outlay.

"4. That it possesses advantages over steam traction in being more free from noise, entirely free from smoke, steam, or fumes, and less unsightly.

"5. That it avoids cruelty to horses.

"6. That it possesses advantages over both steam and horse traction, in uniformity of speed, in admitting of more frequent service, in power of expansion to meet sudden emergencies at little increased cost, in being able to ascend steep grades with ease, and generally it appears to possess fewer inconveniences and annoyances to the householders on the line of route, interferes less with vehicular traffic, and affords greater advantages to the users of the cars than other systems in practical work."

Due consideration was given to locomotives, compressed-air, and electrical motors, but the latter were discarded at an early stage as impracticable or uneconomical.

The Hours of Tramway Men.

THE directors of the North Metropolitan Tramways Company have little or no sympathy with the talk about "slavery" and overwork among their employés to which many of the London public are addicted. Thirteen and a half hours per day of continuous work during a week of ten days, with meals taken on the car, they seem to regard as matters of no great moment. We do not agree with them. Statistics may not perhaps be sufficiently exact to show how much health per annum is lost under these arrangements. That the loss is considerable, we do not doubt. The system is one of unthinking and unwholesome hurry, and cannot fail to balance its money profit by a culpable and extravagant waste of human working power. Snatched meals are condemned by an all but universal trade custom, while the ten-day labor period has been tried before and has failed, even under the daily working conditions of the last century, which were probably far easier than our own.—*The Lancet.*

Expectoration.

THE New York Elevated Railroad has put up the following notice in the new cars recently put on the line:

"Passengers are requested not to expectorate from the car windows."

The number of pigs who travel on the elevated road, and who spit out of the windows, is so large that such a notice was required to restrain them. Their kind are, however, proverbially hard to influence or control, and it is to be feared that the notice will not have its desired effect. It will, however, amuse our English brethren. If their jeers would lessen what some one has called the "abomination of expectoration" in this country, many of us would, however, be willing to submit to them.

Cable Traction.

IN a discussion of this subject before the Institute of Civil Engineers, Mr. J. H. Greathead, as a result of careful investigations, stated that the proportion of power actually or effectually utilized for carrying the live load (*i. e.*, passengers) upon the underground system of railroads in London, was only something like two per cent. of the total maximum power exerted.

Locomotives on Tramways.

STEAM power seems to be very much more extensively used on what they call "tramways" in England, than in this country. One of the manuals published in that country reports 327 engines employed on such roads at the end of 1885.

STREET-RAILWAY NEWS.

ALABAMA.

THE East Lake Land Company has laid out a new town five miles from Birmingham, and will build a street-railroad from there to Birmingham.

At Birmingham, the Birmingham & New Pittsburgh Railroad Company, capital stock $100,000, has been incorporated by Enoch Ensley, Thomas D. Radcliff, Rufus H. Haygood, and others.

CONNECTICUT.

A horse-railroad is to be built at Stamford, and work will be commenced as soon as possible.

GEORGIA.

Covington will soon have another street-railroad. W. C. Clark & Co., of that city, are interested in it.

At Thomasville the building of a street railroad is being agitated, and meets with general approval.

At Dublin a street-railroad is to be built by R. Hightower, J. M. Smith, and others. The work will be commenced soon.

At Atlanta the Metropolitan Street-Railroad Company will extend the Washington street line on Ormond and Pryor streets to the East Tennessee, Virginia & Georgia Railroad. This extension will open up some desirable property for suburban homes.

ILLINOIS.

The North Chicago City Railroad Company is preparing to erect the station at the corner of Elm and Clark streets for the new cable machinery.

The Rapid Transit Car Company has been incorporated in Chicago by James Whalang, Chicago; F. A. Woodford, and others. It was said to be in connection with the North Chicago City Railroad Company, but President Yerkes has denied this.

KANSAS.

The Scott City Street-Railroad Company has been incorporated by T. J. Smith, Charles Noel, and others. Capital stock, $27,000.

The La Crosse, Walnut City & Rush Center Street-Railroad Company, capital stock $150,000, has been incorporated.

At Wichita the Riverside & Suburban Railroad Company has been incorporated to build a railroad from Wichita to the addition of Riverside. Directors, J. O. Davidson, Wm. Innes, and others. Capital, $100,000.

The Dighton & Watson Street-Railroad Company, capital stock $25,000, has been incorporated. The directors are Geo. E. Long, Dighton; A. Horton, Ness City, and others.

KENTUCKY.

Owensboro is to have a street railroad. Geo. M. Fletcher and J. M. Bass, both of Nashville, Tenn., are interested.

MARYLAND.

A branch of the Baltimore & Hampden Electric Railroad, to West Hampden or Sweet Air, formerly operated by horses, is to be converted into an electric line. The electric conductor, however, will be overhead, connecting by a wire and traveler with the motor, instead of being a center rail on which a copper wheel runs, as on the main line.

MASSACHUSETTS.

The directors of the Metropolitan Horse-Railroad Company, of Boston, having voted to introduce electricity or cables, will send a committee to investigate the systems at New York, Philadelphia, Baltimore, Chicago, and other places.

At Fall River the Globe Street-Railroad Company has been authorized to extend its tracks on South Main street to the Shove mill.

MICHIGAN.

The Port Huron Electric Railroad Company, capital $25,000, has been incorporated. W. F. Botsford is one of the incorporators.

MINNESOTA.

The motor line at St. Paul, on the west side, is said to be making money, and to promise to be a financially successful enterprise.

NEBRASKA.

The Omaha Cable Company has been restrained, by a temporary injunction granted to the Omaha Horse-Car Company, from proceeding with the laying of its cable. Unless there is some amicable arrangement made, it is probable that much litigation will ensue.

NEW JERSEY.

All the stock of the West Orange Horse-Car Company has been subscribed for, and the track and stables will be put in hand speedily. The company has applied to the Town Committee for authority to lay tracks on Washington street to Valley road.

NEW YORK.

Proposed extensions of the St. Nicholas Avenue & Cross-Town Railroad Company are as follows: From Harlem River along East 116th street, and Manhattan avenue to the north end of St. Nicholas avenue; from St. Nicholas avenue along 126th street, Lawrence street, Broadway, 129th and 130th streets; from St. Nicholas avenue along 131st street to Fourth avenue, and 128th street to Second avenue; along Third avenue, 129th street to Fourth avenue; and from 129th street along Fourth avenue east of the Harlem Railroad, to connect with tracks at 128th street.

The Third Ward Street-Railroad Company, of Syracuse, proposes to extend the line as at present projected to Burnet Park, making the road six miles long.

NORTH CAROLINA.

The Raleigh Street-Railroad Company will soon begin work on a new line in that city.

PENNSYLVANIA.

The Van De Poele Electric Manufacturing Company has contracted to build 2¾ miles of electrical road for the Scranton Suburban Railroad Company. This is one of several projects for electric street-railroads now under consideration in several cities of this State.

TENNESSEE.

At Memphis it was recently proposed to sell the two street-railroads to a syndicate composed of Boston and New York capitalists; to form a new company with a capital of $250,000. The lines cover over 30 miles of streets and the price was to be $1,000,000. The scheme fell through in consequence of the refusal of one small stockholder to sell his stock. W. D. Bethel, of Memphis, acted as the representative of the eastern syndicate.

TEXAS.

At Marshall a company has been formed by Charles Cobb, W. L. Sloan and C. A. Ginnocho, to build a street-railroad.

VIRGINIA.

A street-railroad is to be built from Old Point Comfort to Hampton. It is expected to receive considerable patronage from visitors and tourists.

WISCONSIN.

The Van De Poele Electric Street-Railroad in Appleton has been put into operation with very satisfactory results.

The Menasha Street-Railroad, according to the contractor, Mr. George Wolff, will be completed to Appleton by October. Some trouble has been experienced in getting the rails, causing considerable delay.

FOREIGN.

CANADA.

The Toronto Electric Light Company has built a new locomotive for the electric railroad at the exhibition. It is of a novel design and is about 40-horse power. The headlight, car-lamps, signal-bell, braking, stopping and starting will all be operated by electricity, controlled by switch-levers on the forward end of the motor-car.

The Montreal Street-Railroad Company is getting most of its cars built in the Dominion. Closed cars have been ordered in the States, as Canadian manufacturers have not the facilities for constructing such cars in time. All the open cars are built by Lariviere, and ten more were recently ordered. Next year the closed cars, which cost $1,000 each, will be ordered from there, probably. Lariviere (of Montreal) is also building twenty sleighs for the company. The car-wheels come from Baltimore, Md.

FRANCE.

In Paris, in 1885, the number of passengers carried by the street-railroads, Belt Railroad, omnibuses, and river steamers on the Seine, was 277,944,000.

SYRIA.

It has rather a queer sound to hear that the first horse-railroad in the country is being built by a native company in the ancient city of Damascus.

THE cable system is about to be adopted at Birmingham, England, on about six miles of road, and in Edinburgh about five miles. In the first-named town the road is practically level, but at Edinburgh there are some rather stiff gradients.

Manufactures.

THE ROGERS LOCOMOTIVE AND MACHINE WORKS.

(Continued from page 182.)

CHAPTER IV.

HISTORY OF LOCOMOTIVE BUILDING AT THE ROGERS LOCOMOTIVE AND MACHINE WORKS.

ON the death of Mr. Thomas Rogers, which occurred in 1856, the business theretofore conducted by Rogers, Ketchum & Grosvenor was reörganized under a charter, with the title of The Rogers Locomotive & Machine Works, and Mr. William S. Hudson was then appointed superintendent. He was a prolific inventor and an excellent mechanic, and introduced many improvements in locomotive construction, which will be described further on.

The first "Mogul" engine, Fig. 26, built at the Rogers Works, was completed in 1863. This plan of locomotive was made possible by the invention of the Bissell truck and the addition of the swing links to it by A. F. Smith, both of which will be described in another chapter. With a single axle-truck in front of the cylinder, the front driving-wheels can be placed farther forward than they can be on a ten-wheeled engine with a four-wheeled truck, one axle of which is in front, and another behind the cylinders. Consequently "Mogul" engines have a larger proportion of their weight on the driving-wheels than ten-wheeled engines have, and this has brought the "Moguls" in favor for freight service.

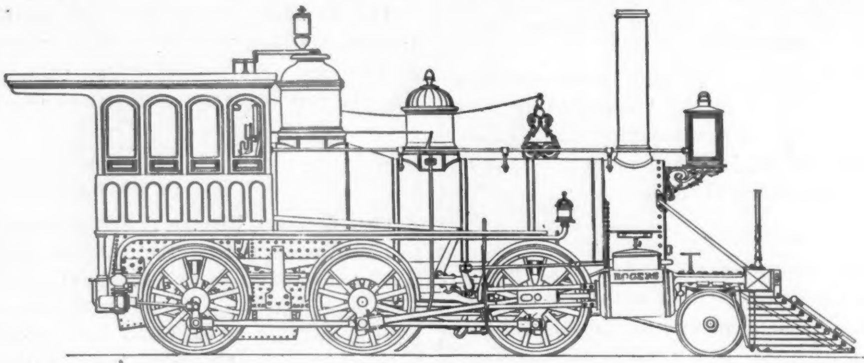


Fig. 26.

The demand for more powerful locomotives naturally suggested coupling four pairs of wheels, and led to the "consolidation" type, which has eight driving-wheels coupled, and a pony truck in front of the cylinders. In 1880, the first "consolidation" engine built at the Rogers Works was completed.

The types of engines which have been described, are the principal ones which have been evolved in this country for ordinary freight and passenger service. Besides these there has been a demand for locomotives for special service, such as switching, urban and suburban traffic, and for narrow-gauge railroads; the narrowness of which made it essential to design special methods of construction.

The most common plan used for switching-engines is that which has four-coupled wheels, both axles being placed between the furnace and smoke-box. Separate tenders are furnished with locomotives of this kind, or the tanks may be placed on top of the boilers.

When more powerful engines are required, six-coupled wheels are used with the axles, all between the furnace and smoke-box. Some six-coupled engines have been built with an axle behind the fire-box, but with this arrangement the overhanging weight of cylinder, smoke-box, etc., brings an undue amount of weight on the front pair of wheels.

The advantage of locating the driving-axles between the furnace and smoke-box is, that the overhanging weight of the furnace behind balances that of the cylinders, smoke-box, etc., in front, and in this way the driving-wheels carry the whole weight of the engine, and it is equally distributed upon them. Placing the water-tank on top of the boiler is inconvenient and unsightly, and when in that position it is difficult to get room enough for an adequate supply of water, and there is also the disadvantage of a varying load on the driving-wheels, which may be excessive with the tank full, and insufficient when it is empty. For these reasons Mr. Hudson, after he became superintendent of the Rogers Works, turned his attention to devising methods of construction which would retain all the advantages of the arrangement of axles described, but which would at the same time give a longer wheel-base for steadiness, but with sufficient flexibility to enable the engine to run round sharp curves easily. The requirements of suburban and other traffic, in which engines must make short runs, had also created a demand for locomotives which could be conveniently and safely run both ways, and which would not require to be turned around at the end of each journey. Having these objects in view, Mr. Hudson, in 1867, designed and patented the plan of tank locomotive, represented by Plate I, which soon became known as "Hudson's Double-Ender." In this, the two driving-axles were placed between the furnace and smoke-box, and a Bissell truck was placed at each end of the engine. Mr. Hudson's patent was dated May 7th, 1867, and was reissued December 7th, 1875.

It will be seen that the water-tank of these engines was on top of the boiler. This arrangement was open to the objections which have been pointed out. To overcome these Mr. Hudson, in 1872, designed and patented the plan of engine represented by Plate II. In this the arrangement of the driving-axles and the front truck, excepting the equalizing arrangements, are the same as in the

Plate I.

HUDSON'S EIGHT-WHEELED DOUBLE-END LOCOMOTIVE.

Plate II.

HUDSON'S TEN-WHEELED DOUBLE-END LOCOMOTIVE.

"Double-Ender" plan, but instead of a two-wheeled Bissell truck behind, a four-wheeled swing-motion truck was substituted, and the water-tank instead of being placed on top of the boilers, was placed over the four-wheeled truck. This arrangement was patented July 16th, 1872.

In 1866, Mr. M. N. Forney patented the plan embodied in the engine shown in Plate III. A number of engines of that kind have been built at the Rogers Locomotive Works for various roads. Whether a leading truck is essential for engines of this class has been a subject of a good deal of controversy among railroad engineers. To reconcile the views of the various parties to this dispute, the Rogers Works build locomotives either with or without the leading truck, as required, leaving to the purchaser and user the task of determining whether a leading truck is useful or not.

In 1872, Mr. Hudson took out seven patents for different plans of tank engines with trucks at each end. In all of them his system of equalizing levers between the trucks and driving-wheel springs, which is described in another chapter, was used, and his patents were chiefly for various applications of that system.

He also patented, in 1873, a plan for a compound locomotive. This had two outside cylinders in the usual position, the one being of larger diameter than the other. It was intended that, ordinarily, live steam from the boiler should be admitted to the small cylinder only, from which it exhausted into a super-heater in the smoke-box before it passed into the large cylinder on the opposite side. The steam-pipe was connected with the steam-chest of the large cylinder by another pipe of smaller diameter. Live steam could be admitted by the small pipe to the large cylinder, if required. This plan was never put into practice.

Mr. Hudson's death occurred on the 20th of July, 1881. He was then 72 years old.

The following extracts are taken from an account of his life, which appeared in the *Railroad Gazette* immediately after his death:

"He was born near the town of Derby, England, in 1809, and at an early age began to learn the trade of an engineer and machinist, serving part of his apprenticeship under George Stephenson. In 1833, when 24 years of age, he came to this country, and for a time found work in the engine room and machine shops attached to the Auburn State Prison in New York. He soon left that place, however, and engaged as a locomotive runner on the old Rochester & Auburn Railroad, now a portion of the New York Central. Subsequently he ran an engine on the Attica & Buffalo Railroad, and was made master mechanic of the road, which he left in 1852 to become superintendent of the locomotive works of Rogers, Ketchum & Grosvenor, at Paterson, N. J. In 1856, these works were incorporated as the Rogers Locomotive and Machine Works, and Mr. Hudson was made mechanical engineer and superintendent, a position which he held until his death. He succeeded Mr. Thomas Rogers, who was the founder of these works, and who probably did more than any other man to develop the design and improve the construction of the American locomotive as it is to-day. But Mr. Hudson took up the work where Mr. Rogers left it, and during the 30 years that Mr. Hudson occupied the position of the head of the mechanical department of this establishment, he made many improvements in the locomotives built there, chiefly of a kind which are the result of simplifying details, adopting better methods of putting work together, and making the engines more substantial and more serviceable. He studied, as probably no other locomotive builder did, the performance of the engines he built. He was constantly looking out for their weak points, and it was said by the present head of the establishment, that Mr. Hudson was always more concerned about building a good engine than he was in making a good profit."

(*To be continued.*)

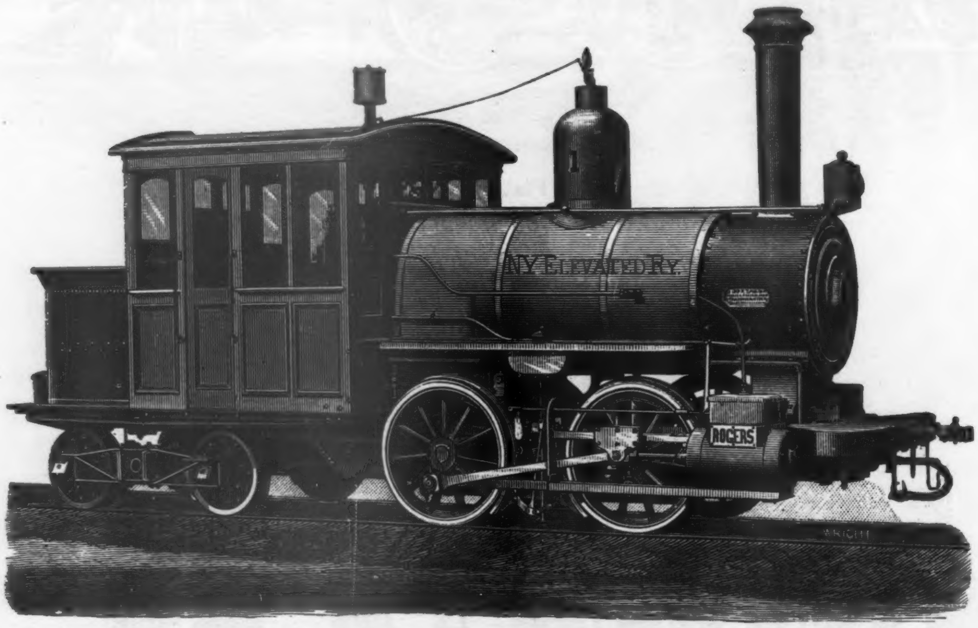


Plate III.

FORNEY LOCOMOTIVE.

A CONSIDERABLE number of engines now building have the Wootten fire-box, which is now to be tried on a large scale on both the Erie and the Baltimore & Ohio. On the latter line it is intended to burn small soft coal, while on the former line the Wootten fire-box is to be used because it is considered the most suitable for anthracite coal, and the latter is considered to annoy the passengers least with dust and cinders. It will, therefore, be seen that the Wootten fire-box is to be tried for distinct reasons in each case.

New Inventions.

Roswell's and Conger's Railway-Signal.

ELISHA R. ROSWELL and GEORGE H. CONGER, of Stratford, Conn., are the inventors of a new and improved form of railway-signal, the construction and operation of which is herewith illustrated and described.

The object of this invention is to improve the manner of operating the signals at railway-stations, which indicate to the engineer of an incoming train the character and time of departure of the train preceding him, and consists in arranging the various signals on the faces of a series of independent drums adapted to be revolved, so that any desired signal may be brought to view by a series of sleeves or hollow shafts, one within the other, to which certain of the drums are attached, so that said drums may be turned independently without disturbing others in the same line.

In the accompanying cuts, Fig. 1 represents a view in perspective of two frames or boxes, each containing a complete set of signals; Fig. 2 represents a front elevation and sectional view of one of the signal-frames; Fig. 3 represents a sectional view through dotted line *x* of Fig. 2; Figs. 4 and 5 represent detail views, and in construction and operation are as follows:

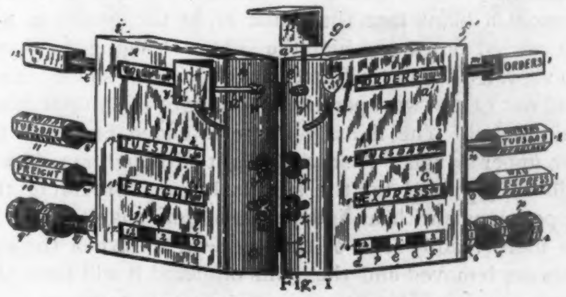


Fig. 1

ROSWELL AND CONGER'S RAILWAY-SIGNAL.

A B are the frames containing the signals; *a b c d e f g h i j k l*, signal-drums within the frames; 1 2 3 4 5 6 7 8 9 10 11 and 12, duplicate drums on the outside of the signal-frames; *m n o p q r s t*, shafts to which said drums are attached; *u v w x*, thumb-nuts on the ends of said shafts *n o r s*; 13 14 15 16 17 18 19 20, openings in the frames through which the signals may be seen; *y y'*, lights; 21 22, shades for same; *b' c'*, sleeves or hollow shafts; C, section of wall.

At railway stations, and situated at one end of the platform, is a set of signals to indicate to the engineer of an incoming train the exact time of departure and also the character of the train preceding him. These signals are slips or tablets of wood having the necessary signals thereon. It requires at least five of these tablets to complete a set, four of which have to be changed for every train. This device is cumbersome, taking up considerable space, besides requiring the attention of an extra man to operate it, and whose duty it is, when the signals are set, to report the same immediately to the telegraph operator. In this device the signals are arranged about the circumference of a cylinder or drum adapted to be revolved. These drums are placed in a frame or box near the depot and operated from the inside, preferably by the telegraph operator.

In Fig. 1 is shown a set of signals consisting of the two frames A B, one an exact counterpart of the other, and hinged at *e' e'*. This matter of hinging will serve to prevent the misplacement of the two sections, enabling them to be placed at the proper angle, so that the signals can be readily seen by the engineers of trains approaching from opposite directions. The drums *a b c g h i*, are rigidly attached to the shafts on which they are placed. These shafts are journaled in the sides *f' g' h' i'*, of the frames A B. The front elevation and sectional view of frame B, as seen in Fig. 2, which is a counterpart of the other frame A, will fully show the construction of the device. The signal-drums may be plain cylinders instead of the many-sided figures, as shown; but it is thought by placing the signals on a flat surface they can be seen more readily.

a is a square drum, having on one of its faces the word "Orders," the other faces being blank; *b*, having sides corresponding to the days of the week and one blank face; *c*, having a sufficient number of sides to represent the character of all trains liable to run over the road, and having one blank face. *d* is a drum whose sides contain figures

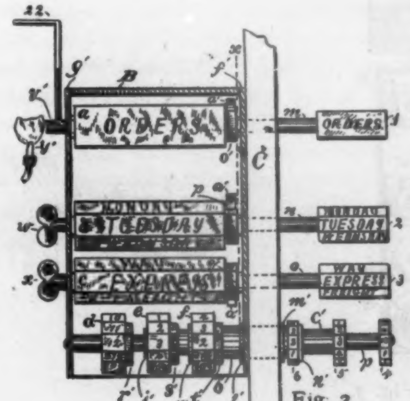


Fig. 2.

ROSWELL AND CONGER'S RAILWAY-SIGNAL.

ranging from 1 to 12, representing the hours, having also one face left blank. *e* is a like drum, containing figures from 0 to 5; *f*, a drum containing figures from 0 to 9. As the drum *d*, would contain thirteen faces, and the drums *e f*, are the same size, so that their faces may be on a line with *d e* and *f*, therefore having a less number of figures and as many sides as *d*, would have sufficient blank space for the purpose, which will hereinafter be more fully described.

The frames containing the signals are placed outside the telegraph operator's office, and the shafts on which the drums are situated project through the wall, as represented by C, and into the office. On the said shafts, within the building, are placed duplicate drums of those on the outside, having on their faces the same characters. Thus, the operator, in setting the signals, will place the drums on the inside as they should appear in the signal-boxes. The drums *d e f*, are placed on the shaft *p*, and hollow shafts or sleeves *c' b'*, a better view of which may be seen at Figs. 4 and 5; Fig. 4 being a sectional view of shaft, sleeves and drums through dotted line *x'* of Fig. 3. The sleeve *c'*, is supported on shaft *p*, turning freely thereon. On one end of said sleeve, and within the signal-box, is placed the drum *e*. On the other end, and

within the office, is the drum 5, the sleeve b', loosely fitting sleeve c', and having on its extreme ends the drums f and 6. The collars j' k' l' m' n', serve to keep said sleeves in position and prevent end-play. Turning drum 4, will operate drum d, 5 will operate e, and 6 will move f, so that any one in the line may be turned without disturbing any of the others. This independent movement of said drums is necessary to set the proper combination of figures to denote the hour and minute.

The two frames A and B, form the sides of an angle more or less acute, the point at which they are hinged forming the apex and projecting toward the track. The base of said angle, which is open, will face the station. The signal-frames may be set against the station wall or at any desirable distance therefrom. The angle at which the frames A and B, are placed will depend somewhat on the relative position of the station and track. If the station is situated at a curve on the road, the angle of said frames would be more acute than if the road and station were parallel, the object being to set them in such positions in relation to the track that they may be readily seen by the

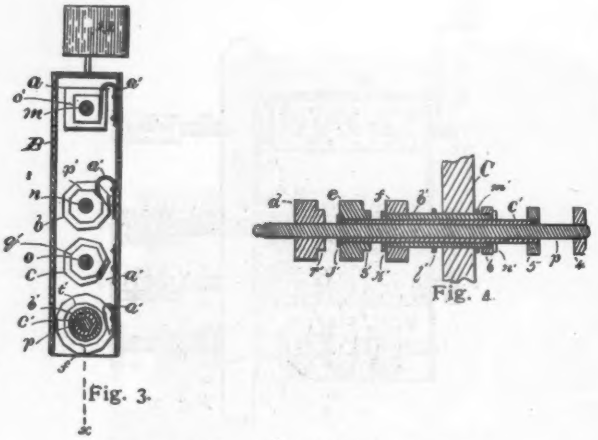


Fig. 3. Fig. 4.

ROSWELL AND CONGER'S RAILWAY-SIGNAL.

engineers of trains approaching from opposite directions. For instance, let it be supposed a train is going north, then the face of signal-frame A, is the only one seen by the engineer, and he will observe that the last north-bound train was a freight, and left the station at 12:20. Likewise, the engineer of a south-bound train will see by the signals set in frame B, that the train he is following is an express, and left that station at 12:32. It is of the greatest importance to the engineer about to leave the station to know the character as well as the time of departure of the train he is following. If it is a freight and his a passenger, and the time short between the trains, he will run with extreme caution.

o' p' q' r' s' t', as seen in Figs. 2 and 3, are reduced portions of the drums a b c d e f, and having the same number of faces as the main body of the drum. Against these smaller faces the springs a', act and operate as a brake to hold the signals in the position in which they may be placed. The thumb-nuts u v w x, on the ends of shafts n o r s, and outside of the frames A B, enable the operator to set the signals on said shafts from the outside should he happen to be on the platform when they required changing. At such times the drums d e f, having figures thereon, can be manipulated from beneath the box or frame, the same being open at the bottom.

The upper signals—viz., "Orders"—(see Fig. 1) are placed on one of the faces of the rectangular drums a g. These are intended as special signals. With this device, when necessary to stop a train for what is in railway parlance termed "Orders," the upper signal a, is set in the same manner as the others, and the engineer, knowing that nothing serious has occurred to stop his train, as the customary red flag or light would seem to indicate, continues on, so that the conductor may step from his car into the telegraph office, in place of the usual loss of time consumed by the present system of simply stopping a train by the danger signal, irrespective of the cause. When this signal is not required, the drum is turned and presents one of its blank faces, as seen in frame

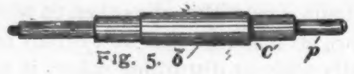


Fig. 5.

ROSWELL AND CONGER'S RAILWAY-SIGNAL.

A, Fig. 1. At night lights y y', are used to throw a light on the upper signals. Attached to the ends v' w', of the shafts m t, which project through frames A B, are the rods a^2 a^3, supporting the shades 21 and 22. These shades are secured firmly to shafts m and t. Thus when the drum g (see frame A, Fig. 1), is turned so as to present a blank face, the shade 21, by the operation, will be carried down and hide the light. Bringing the signal to view, as shown in frame B, also carries shade 22, up and out of the way, permitting the light to shine fully on said signal. The lights y y', are intended expressly for the upper signals. A separate light, although not shown, will be provided for the signals below. Providing the upper signals with an independent light enables them to be more readily seen by the engineer, and when the signals are removed and the lights obscured it will leave the upper portion of the frame in comparative darkness.

Having brought the shafts through the wall into the office, they are then brought down to the operator's table, making it unnecessary for him to leave his chair to set any desired order or time.

All inquiries and communications should be addressed to Roswell & Conger, No. 19 Burrough street, Bridgeport, Conn., the inventors, who have sole control of the invention.

Lippincott's Siphon Oil-Can.

THOMAS W. LIPPINCOTT, of Rockford, Ill., is the inventor of a new and improved form of siphon oil-can, which is herewith illustrated and described.

In the accompanying cuts, Figure 1 represents a central vertical section of a can and stopper B, and side views of pipes and other devices connected therewith; and Fig. 2, an elevation of the neck of the can and pipes, showing how evaporation of the oil or other liquid is to be prevented when the device is not in use in filling lamp-bowls.

A indicates the can; B, the plug or stopper inserted into the neck of the can, where it is held by friction, it being made of cork or other suitable elastic material, and tapered in form, as shown. C is a tube extending down through the stopper to near the bottom of the can, and extending a short distance above the stopper. F is an-

other tube, extending through the stopper a short distance above and also below the stopper at a slight inclination to tube C, as shown. G is a flexible pipe, of rubber or other suitable material, the upper end of which is sprung over the top end of tube F, while its lower end is provided with a mouth-piece K. D is another flexible tube, of like material, sprung over the upper end of the tube C, and it leads into a lamp-bowl or other vessel E. The tubes C and F, should be made of metal or other material that will resist the action of oil or of any acid liquid that might corrode or destroy them. These tubes should be placed at just such distance apart as to leave sufficient space between them into which the pipes D and G, can be closely compressed, as hereinafter specified. These tubes will be held in their positions in the stopper by the elasticity of its material without other fastening.

The theory of the operation of the device is, that when the can is filled, or partly filled, with any liquid—oil, for instance—and air is forced in upon the liquid by blowing from the mouth—for instance, into pipe K—the liquid will be forced by the air up the tube C, into the pipe D, and thence into the lamp F′, and when it has begun to

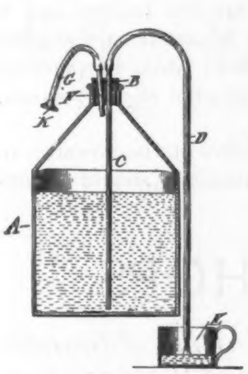


Fig. 1.

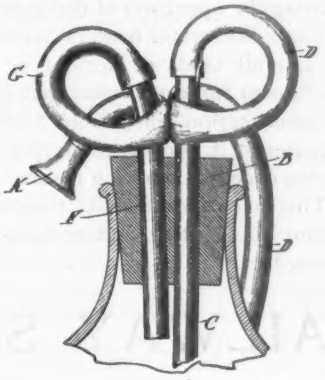


Fig. 2.

LIPPINCOTT'S SIPHON OIL-CAN.

flow it will continue to flow without further compression of the air in the can, provided the lamp-bowl be lower in position than the liquid in the can; but if the lamp be raised while the flowing is going on to a higher position than the surface of the liquid in the can, the current will be reversed and the lamp-bowl emptied into the can again. The tube G, having no valve, then so soon as the liquid is started to flowing, either out of the can into the lamp or out of the lamp into the can, the pipe G, remains open, though it be in a pendant position, as shown in the cuts, and allows free passage of the air both ways. If, however, both pipes D and G, were left open when the device was not in use for the transfer of liquid, the liquid in the can would waste or give offense by evaporation. This is prevented simply and effectually by bending each of the flexible pipes D and G, and placing them between the two tubes C and F, and pressing them down into the space between the tubes, and so compressing the pipes as to prevent the passage of either air or vapor either way, as shown in Fig. 2.

It will be readily seen that the perfect operation of this device is secured without the use of valves, stop-cocks or other complicated parts, and that when not in operation no such parts are needed, evaporation being effectually stopped.

An especially valuable feature of this invention is that it is equally well adapted to any form of receptacle capable of holding oil (or indeed any other liquid), in the mouth or orifice of which the plug or stopper B, can be inserted, and is equally useful with either jug, bottle, demijohn or the ordinary form of can; the stopper B, working as well in a metal screw-threaded throat as in the smooth neck of a jug or demijohn.

It is claimed by the inventor that the device is simple, economical and efficacious, and perfectly adapted to the purpose to which it is applied; while it is far neater and easier of management, as it avoids the usual drip and overflow, thus making it much safer, especially in shops and where many lamps are used, than the ordinary form of can.

Galligan's Feed-Water Heater.

MICHAEL J. GALLIGAN, of Cedar Rapids, Iowa, is the inventor of a new and improved form of feed-water heater, which is herewith illustrated and described.

This invention consists in the application of a feed-water heater to the under side of the fire-box of a steam boiler, and in the construction and arrangement of the connecting-pipes, the object being to use the top of the heater for the bottom of the ash-pit, thus utilizing the heat thereof to raise the temperature of the water beneath, and by the arrangement of the pipes admit of the cleaning out of the heater while the boiler is in operation.

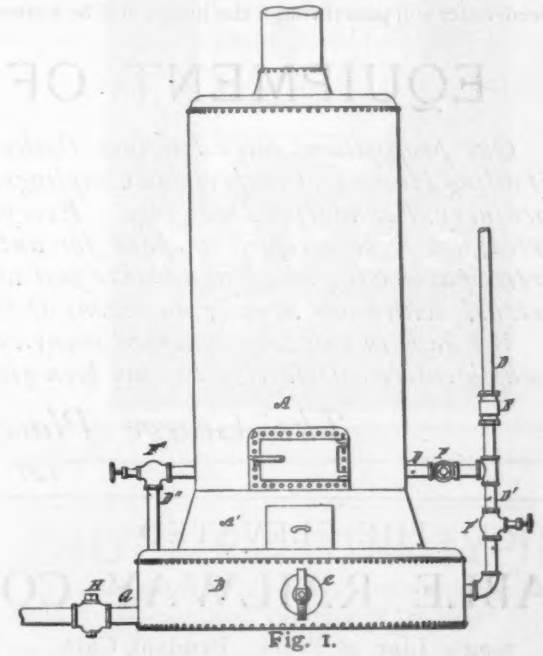


Fig. 1.

GALLIGAN'S FEED-WATER HEATER.

In the accompanying cuts, Figure 1 represents a front elevation of the invention as applied to an upright boiler; and Fig. 2, a vertical section of the same detached.

A indicates the boiler, and A′, the fire-box. This boiler may be upright or horizontal, the invention being applicable to either, though, of course, more particularly applicable to such boilers as are provided with an attached

fire-box, and commonly known as "portable boilers," either horizontal or upright. The heater B, consists of a drum, preferably somewhat larger superficially than the bottom of the fire-box, and comparatively shallow, as indicated in the cuts. It is provided with one or more hand-holes C, for convenience of access to the interior in cleaning or otherwise. It is desirable that the whole interior of the heater should be unobstructed, in order that it may be cleaned without difficulty; therefore, stay-rods are dispensed with in the construction of the heater, and to give the two larger sides of the same the necessary resistance to outward pressure they are made concave, as

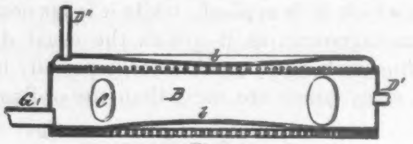


Fig. 2.
GALLIGAN'S FEED-WATER HEATER.

represented in Fig. 2. This not only serves to strengthen the heater, but, in the case of the upper side, forms a considerable receptacle for ashes. A feed-pipe D, communicates directly with the boiler and with the pump or injector. It also communicates directly with a branch pipe D′, passing into the heater. Further connection is made between the heater and the boiler by pipe or pipes D″. The feed-pipe is provided with a suitable check-valve E, and the connecting-pipes with globe-valves F F′ F″, respectively. It will be seen that when the valve F, is open and the others closed the feed-water will flow directly into the boiler, and when this one is closed and the others opened the feed-water will pass through the heater and be warmed by the heat of the fire-box and ashes above it. In general the water will, of course, be conveyed to the boiler in this way; but when it is desired to clean out the heater the feed-water may be injected directly into the boiler, and the heater emptied without stopping the engine or interfering materially with the action of the boiler. For this purpose the heater is provided with a suitable blow-off pipe G, having a gate H. When it is desired to blow out the whole boiler, all of the connections with the heater should be opened, in which case the impact of the steam at various points in the heater tends greatly to facilitate the removal of mud and other impurities collected therein. Thus constructed and applied, the heater forms a natural and suitable base for the boiler, dispensing with any brick-work or other erection for that purpose, and constitutes a part of the ash-pit. The heater thus occupies no extra room, and, being contiguous to the fire-box, receives much of the heat thereof that otherwise would be wasted. Its position is such as to render it the receptacle for all mud and impurities from the water and boiler, and its construction is such as to make the removal of all this easy and expeditious, and without necessarily discontinuing the operation of the boiler.

These feed-water heaters can be either round or square, to suit all kinds of upright or fire-box boilers, and it is claimed for the device that it is simple and durable in construction, and easily handled; while by practical experience it proves admirably adapted to its purpose, giving excellent working results.

The invention is under the control of the inventor, to whom all inquiries and communications should be addressed.

Vol. 60 No. 1

The American Railroad Journal

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WOLCOTT'S
PATENT
Dumping-Car and Car-Dump.

This invention furnishes a means for unloading Grain, Coal, Ores, and other Freight, from Platform, Gondola or Box-Cars, and by its use one or more Cars can be dumped at the same time by an extended Dump-Track which may be coupled out to any desired length.

A full description of both devices, with their application, was published in the November JOURNAL.

For particulars, address the Inventor and Patentee,

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PUBLICATION OFFICE:
No. 323 PEARL STREET (Franklin Square),
NEW YORK.


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AMERICAN RAILROAD JOURNAL

ESTABLISHED 1831.

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No. 323 PEARL STREET (Franklin Square),
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AMERICAN RAILROAD JOURNAL

ESTABLISHED 1831.

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AMERICAN RAILROAD JOURNAL

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No. 323 PEARL STREET (Franklin Square)
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